



BSI Standards Publication

UHV AC transmission systems

Part 303: Guideline for the measurement of UHV AC
transmission line power frequency parameters

National foreword

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TECHNICAL REPORT

**UHV AC transmission systems –
Part 303: Guideline for the measurement of UHV AC transmission line power
frequency parameters**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

UHV AC TRANSMISSION SYSTEMS –

**Part 303: Guideline for the measurement of UHV AC
transmission line power frequency parameters**

FOREWORD

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IEC TR 63042-303 has been prepared by IEC technical committee 122: UHV AC transmission systems. It is a Technical Report.

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

DTR	Report on voting
122/105/DTR	122/112/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/standardsdev/publications.

A list of all parts in the IEC 63042 series, published under the general title *UHV AC transmission systems*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://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- withdrawn,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.

INTRODUCTION

AC transmission line power frequency parameters are important basic data used for various power system's calculations and applications, including engineering design verification, commissioning, and operation.

Due to the complication of the geological conditions along the corridor of long distance UHV AC transmission lines, it is difficult to obtain accurate transmission line power frequency parameters through theoretical analysis and calculation. To obtain the accurate power frequency parameters, a field measurement is necessary.

This document provides the guidance for measurement of UHV AC transmission lines power frequency parameters which include sequence parameters and phase parameters, etc. The measurement conditions, measurement methods, data process methods, safety requirements, etc. are described.

UHV AC TRANSMISSION SYSTEMS –

Part 303: Guideline for the measurement of UHV AC transmission line power frequency parameters

1 Scope

This part of IEC 63042 specifies measurement methods of UHV AC transmission line power frequency parameters. These measured parameters mainly include sequence parameters, mutual parameters between double-circuit lines, phase parameters and some other related parameters.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC Guide 115:2007, *Application of uncertainty of measurement to conformity assessment activities in the electrotechnical sector*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

offset frequency method

method that can measure the parameter of transmission line by applying a test power source with a frequency offset from the power frequency

3.2

source terminal

terminal of a transmission line, at which a power source is applied for the parameter measurement

3.3

ending terminal

terminal opposite to the source terminal of a transmission line

3.4

one-terminal measurement method

measurement method, at which only source terminal is measured

3.5**two-terminal synchronous measurement method**

measurement method at which both source terminal and ending terminal are measured synchronously

3.6**phase parameter**

type of power frequency parameters, which characterize electric and magnetic coupling characteristic for single phase or between two phases, including self-impedance, mutual impedance, self-capacitance and coupling capacitance

3.7**induced voltage**

voltage caused by the electromagnetic or electrostatic effect of adjacent energized lines or equipment

3.8**induced current**

electric current resulting from the displacement of charge carriers due to an induced voltage

[SOURCE: IEC 60050-121:2008, 121-11-29]

4 General**4.1 Background**

Due to the complication of the geological conditions along the corridor of long distance UHV AC transmission lines, where soil resistivity and transmission tower size vary, it is difficult to obtain accurate transmission line power frequency parameters through theoretical analysis and calculation. To obtain the accurate power frequency parameters, field measurement is necessary. However, the accuracy of field measurement is influenced by measurement methods due to the distributed characteristic and electromagnetic coupling of UHV AC lines. Therefore, appropriate measurement methods are important to obtain accurate power frequency parameters. In this document, different measurement methods are applied to acquire accurate parameters.

4.2 Measurement items

The recommended parameters which need to be measured are as follows:

- positive-sequence impedance,
- positive-sequence capacitance,
- zero-sequence impedance,
- zero-sequence capacitance,
- mutual impedance and coupling capacitance between double-circuit lines,
- self-impedance of one phase,
- self-capacitance of one phase,
- mutual impedance between two phases,
- coupling capacitance between two phases,
- induced voltage and induced current,
- phase verification and insulation resistance,
- DC resistance.

4.3 Main circuit configuration

Disconnectors at the two terminals of the transmission line should be open during measurement.

Parallel with the transmission line, connected equipment should be disconnected, such as shunt reactors and capacitive transformer.

Series reactors and capacitors used in the transmission line shall be bypassed.

If the transmission line to be measured is composed of overhead lines, cables or gas-insulated lines (GIL), it is recommended to measure the parameters of the overhead lines, cables or GIL, separately.

To eliminate the resistance of the connecting lines for test, two connecting lines, i.e. voltage and current connecting lines, can be applied. If only one connecting line is applied, the obtained line resistance should be reduced by the connecting line resistance. The measurement system should be reliably connected to the substation earthing system.

4.4 Measurement condition

Close attention should be paid to the weather condition along the line during the measurement. The measurement should be stopped if the weather is not suitable for measurement.

Ambient temperature of measuring instrument: $-10\text{ }^{\circ}\text{C}$ to $+40\text{ }^{\circ}\text{C}$, relative humidity: $\leq 85\%$.

Before starting the measurements, check that all temporary grounding connections have been removed. No work may be done on the lines during the measurements. Make sure that this rule is followed. All local and international safety regulations shall be known and strictly observed. Safety precautions are given in Annex C.

5 Requirement of measuring instrument

5.1 Current transformer

Uncertainty of current transformer (CT) should be equal to or better than 0,5 %. It is obtained based on the method of IEC Guide 115.

5.2 Voltage transformer

Uncertainty of voltage transformer (VT) should be equal to or better than 0,5 %. It is obtained based on the method of IEC Guide 115.

5.3 Measuring instrument of DC resistance

The instrument to measure the DC resistance of a transmission line can be a special instrument or the combination of a DC power source, a DC voltmeter and a DC ammeter.

If the DC resistance measurement meter is used, its uncertainty should be equal to or better than 0,5 %.

If the combination of a DC resistance, a DC power source, a DC voltmeter and a DC ammeter is used, the uncertainty of the DC voltmeter and ammeter should be equal to or better than 0,5 %.