

TECHNICAL SPECIFICATION



**UHV AC transmission systems –
Part 102: General system design**

ITEH STANDARD PREVIEW
(standards.iteh.ai)

[IEC TS 63042-102:2021](https://standards.iteh.ai/catalog/standards/sist/80e5ab54-dc7e-4668-9df9-42d7f49cce40/iec-ts-63042-102-2021)

<https://standards.iteh.ai/catalog/standards/sist/80e5ab54-dc7e-4668-9df9-42d7f49cce40/iec-ts-63042-102-2021>



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2021 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC online collection - oc.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

[IEC TS 63042-102:2021](https://standards.iteh.ai/catalog/standards/sist/80c5ab54-dc7e-4668-9d9-42d7f49cce40/iec-ts-63042-102-2021)

<https://standards.iteh.ai/catalog/standards/sist/80c5ab54-dc7e-4668-9d9-42d7f49cce40/iec-ts-63042-102-2021>

TECHNICAL SPECIFICATION



**UHV AC transmission systems –
Part 102: General system design**

STANDARD PREVIEW
(standards.iteh.ai)

[IEC TS 63042-102:2021](https://standards.iteh.ai/catalog/standards/sist/80e5ab54-dc7e-4668-9df9-42d7f49cce40/iec-ts-63042-102-2021)

<https://standards.iteh.ai/catalog/standards/sist/80e5ab54-dc7e-4668-9df9-42d7f49cce40/iec-ts-63042-102-2021>

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.240.01; 29.240.10

ISBN 978-2-8322-1012-7

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	6
INTRODUCTION.....	8
1 Scope.....	9
2 Normative references	9
3 Terms and definitions	9
4 Objective and key issues of UHV AC transmission application	9
4.1 Objective	9
4.2 Key application issues	10
5 Required studies on UHV AC system planning and design.....	10
5.1 General.....	10
5.2 Required studies.....	11
5.3 Required analysis tools	11
6 UHV AC system planning.....	13
6.1 General.....	13
6.1.1 Introductory remarks.....	13
6.1.2 Transmission capacity considering routes and line types to use.....	13
6.1.3 Reactive power management issues	13
6.1.4 Environmental issues	14
6.2 Scenario for system planning	15
6.3 Scenario for network planning procedure.....	15
6.3.1 Power transmission capacity.....	15
6.3.2 System voltage.....	16
6.3.3 Route selection.....	16
6.3.4 Series compensation	17
6.4 Required parameters	17
6.5 Transmission network (topology).....	17
6.6 Reliability.....	18
7 UHV AC system design.....	19
7.1 General.....	19
7.2 Reactive power management	19
7.3 Reclosing schemes	19
7.4 Delayed current zero phenomenon.....	21
7.5 Protection and control system	22
7.6 Insulation design (cost effectiveness)	22
Annex A (informative) History of development of UHV AC transmission technologies.....	24
A.1 General.....	24
A.2 History of development in the USA.....	24
A.3 History of development in former USSR and Russia.....	24
A.4 History of development in Italy	24
A.5 History of development in Japan	25
A.6 History of development in China	25
A.7 History of development in India	25
Annex B (informative) Experiences relating to UHV AC transmission development.....	26
B.1 Project development in Italy	26
B.1.1 Background (including network development)	26
B.1.2 Demand analysis and scenario of application.....	26

B.1.3	Project overview	26
B.1.4	UHV system planning	27
B.1.5	UHV system design	28
B.1.6	Laboratory and field tests	29
B.2	Project development in China	32
B.2.1	Background	32
B.2.2	Project overview	32
B.2.3	Changzhi-Nanyang-Jingmen UHV AC extension project.....	33
B.2.4	Overvoltage mitigation and insulation coordination	35
B.2.5	Insulation coordination.....	36
B.2.6	Laboratory and field tests	38
B.3	Project development in India	40
B.3.1	Background (including network development)	40
B.3.2	Demand analysis and scenario of application.....	40
B.3.3	Project overview	40
B.3.4	Development of 1 200 kV national test station in India	41
B.3.5	POWERGRID's 1 200 kV transmission system.....	42
B.3.6	UHV AC technology design – Insulation coordination.....	43
B.3.7	Insulation design for substation	44
B.4	Project development in Japan	45
B.4.1	Background (including network development)	45
B.4.2	Demand analysis and scenario of application.....	46
B.4.3	Project overview	46
B.4.4	UHV system planning	47
B.4.5	UHV system design	47
B.4.6	Laboratory and field tests	50
Annex C (informative)	Summary of system technologies specific to UHV AC transmission systems	53
C.1	Technologies used in China	53
C.1.1	Transformer	53
C.1.2	UHV shunt reactor and reactive compensation at tertiary side of transformer	54
C.1.3	Switchgear	55
C.1.4	Series capacitor (SC)	57
C.1.5	Gas-insulated transmission line (GIL)	59
C.2	Technologies used in India	60
C.2.1	UHV AC transformer	60
C.2.2	Surge arrester	61
C.2.3	Circuit-breakers	62
C.2.4	Instrument transformers.....	63
C.3	Technologies used in Japan	64
C.3.1	Switch gear	64
C.3.2	Surge arrester	65
Bibliography	67
Figure 1	– Analysis tool by time domain	12
Figure 2	– Flowchart of reactive power compensation configuration	14
Figure 3	– π equivalent circuit	15
Figure 4	– Four-legged reactor	20

Figure 5 – One typical reclosing sequence of high speed earthing switches (HSESs)	21
Figure 6 – Procedure for insulation design	23
Figure B.1 – Demand situation in Italy	26
Figure B.2 – UHV transmission lines in Italy as originally planned in '70	27
Figure B.3 – SPIRA system and SICRE system	28
Figure B.4 – Preliminary system design	29
Figure B.5 – Field testing of UHV equipment.....	30
Figure B.6 – UHV AC transmission projects implemented in China.....	32
Figure B.7 – Single-line diagram of Changzhi-Nanyang-Jingmen UHV AC pilot project	33
Figure B.8 – Artificial grounding test of UHV series capacitors in China	34
Figure B.9 – Single-line diagram of Huainan-Zhejiang-Shanghai double-circuit UHV AC project	34
Figure B.10 – Generator integrated into a UHV system through a UHV step-up transformer	35
Figure B.11 –Hubei Wuhan UHV AC test base	38
Figure B.12 –Hebei Bazhou UHV tower test base	38
Figure B.13 – 1 200 kV national test station (India)	41
Figure B.14 – Power flow from Satna to Bina diverted via a 1 200 kV test station (India)	42
Figure B.15 – Schematic of 1 200 kV UHV AC line.....	43
Figure B.16 – Typical V-I characteristic of 1 200 kV MOSA	44
Figure B.17 – Sequence of events for calculation of surge arrester energy accumulation	45
Figure B.18 – Trend of peak demand in Japan.....	46
Figure B.19 – UHV transmission line for each construction year in Japan	47
Figure B.20 – Concept for transmission capacity enhancement with short-circuit current restriction.....	47
Figure B.21 – Insulation design sequence of 1 100 kV transmission lines' air gap clearances	48
Figure B.22 – UHV designed transmission line in TEPCO	49
Figure B.23 – Field testing of UHV substation equipment since 1996	50
Figure C.1 – UHV AC transformer	53
Figure C.2 – UHV AC shunt reactor	54
Figure C.3 – Reactor and capacitor at tertiary side of UHV transformer	55
Figure C.4 – UHV GIS.....	56
Figure C.5 – UHV MTS	56
Figure C.6 – UHV air insulated disconnectors	57
Figure C.7 – Single-line diagram of UHV series capacitor	58
Figure C.8 – UHV series capacitor	58
Figure C.9 – UHV GIL tunnel below Yangtze River.....	59
Figure C.10 – Inside a UHV GIL tunnel during assembly	59
Figure C.11 – 333 MVA transformer for the 1 200 kV test station	61
Figure C.12 – First prototype of 850 kV surge arrester for 1 200 kV system	62
Figure C.13 – UHV circuit-breaker in India	63
Figure C.14 – Instrument transformer	64
Figure C.15 – 1 100 kV gas circuit-breaker	65

Figure C.16 – Resistor-assisted disconnecting operation	65
Figure C.17 – Surge arrester with low protection level	66
Table 1 – Specification of reclosing scheme.....	21
Table B.1 – Specifications of 1 100 kV transformer	30
Table B.2 – Specifications of pilot plant (substation)	31
Table B.3 – Specifications of pilot plant (cable).....	31
Table B.4 – Parameters of substation and switching station of Changzhi-Nanyang-Jingmen UHV AC pilot project.....	33
Table B.5 – Parameters of transmission lines of Changzhi-Nanyang-Jingmen UHV AC pilot project.....	33
Table B.6 – Main system parameters of UHV AC projects in China	35
Table B.7 – Main system parameters of UHV arrester	36
Table B.8 – Required minimum value of clearance of the 1 100 kV transmission line	37
Table B.9 – Minimum clearance of UHV substation (metres)	37
Table B.10 – Overvoltage withstand level of UHV AC projects in China.....	38
Table B.11 – Basic technical parameters for 1 200 kV UHV AC system selected in India	43
Table B.12 – TOV and energy absorption by surge arrester	45
Table B.13 – Requirement against large charging MVA.....	49
Table B.14 – Specifications of substation insulation design.....	49
Table B.15 – Specifications of 1 100 kV transformer	50
Table B.16 – Specifications of 1 100 kV GIS	51
Table B.17 – Example of field test – Measurement items of transformer	51
Table B.18 – Example of field test – Measurement items of GIS	52
Table C.1 – Main parameters of UHV AC typical transformer	53
Table C.2 – Main parameters of UHV AC reactive power compensation equipment.....	54
Table C.3 – Main parameters of UHV AC circuit-breaker	55
Table C.4 – Rated values of UHV SCs in Changzhi-Nanyang-Jingmen UHV extension project	58
Table C.5 – Specifications of 333 MVA transformer for the 1 200 kV test station.....	60
Table C.6 – Technical specifications of surge arrester	61
Table C.7 – Technical parameters of UHV circuit-breaker	62
Table C.8 – Parameters of instrument transformer	63
Table C.9 – Specifications of gas circuit-breaker	65
Table C.10 – Specifications of surge arrester.....	66

INTERNATIONAL ELECTROTECHNICAL COMMISSION

UHV AC TRANSMISSION SYSTEMS –

Part 102: General system design

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

IEC TS 63042-102 has been prepared by IEC technical committee 122: UHV AC transmission systems. It is a Technical Specification.

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

Draft	Report on voting
122/109/DTS	122/114/RVDTS

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 Specification 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 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.

IMPORTANT – The "colour inside" logo on the cover page of this document 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.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[IEC TS 63042-102:2021](https://standards.iteh.ai/catalog/standards/sist/80e5ab54-dc7e-4668-9df9-42d7f49cce40/iec-ts-63042-102-2021)

<https://standards.iteh.ai/catalog/standards/sist/80e5ab54-dc7e-4668-9df9-42d7f49cce40/iec-ts-63042-102-2021>

INTRODUCTION

Large capacity power sources including large-scale renewable energy have recently been developed, but they are generally located far away from load centres. To meet the requirements for large capacity power transmission, some countries have introduced, or are considering introducing, ultra high voltage (UHV) transmission systems, overlaying these on the existing extra high voltage (EHV) systems.

The objective of UHV AC power system planning and design is to achieve both economic efficiency and high reliability, considering its impact on EHV systems.

Moreover, UHV AC transmission systems require comparatively large spaces, and the method of minimizing and optimizing the size and structure of UHV AC transmission lines and substation apparatus is another important issue.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[IEC TS 63042-102:2021](https://standards.iteh.ai/catalog/standards/sist/80e5ab54-dc7e-4668-9df9-42d7f49cce40/iec-ts-63042-102-2021)

<https://standards.iteh.ai/catalog/standards/sist/80e5ab54-dc7e-4668-9df9-42d7f49cce40/iec-ts-63042-102-2021>

UHV AC TRANSMISSION SYSTEMS –

Part 102: General system design

1 Scope

This part of IEC 63042 specifies the procedure to plan and design UHV transmission projects and the items to be considered.

2 Normative references

There are no normative references in this document.

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

extra high voltage EHV

voltages in the range of 345 000 V to 765 000 V

3.2

right-of-way ROW

strip of land that is used to construct, operate, maintain and repair transmission line facilities

3.3

surge impedance loading SIL

power delivered by a line to a purely resistive load equal in value to the surge impedance of that line

3.4

ultra high voltage UHV

highest voltage exceeding 800 000 V

4 Objective and key issues of UHV AC transmission application

4.1 Objective

Recently, large capacity power sources including large-scale renewable energy have been developed, in most cases, far away from the load centres. To fully utilize these facilities, it is important to transmit power generated from these sources efficiently. Evacuation through extra high voltage (EHV) network enhancements would need more lines (right-of-way, ROW) and substations, increasing transmission losses and worsening fault current problems.

UHV transmission systems are characterized by their large capacity over long distances and can provide a solution to address the above issues by minimizing ROW and switchyard requirements, effectively with fewer losses, improvement of fault current conditions, etc.

For example, the transmission surge impedance loading (SIL) capacity of a 1 100 kV transmission line can replace four to five 550 kV lines, the weight of the towers can be reduced by approximately 30 % and the weight of the wires by approximately 50 %. This can provide savings on the cost of construction of power lines and substations.

A UHV transmission system has many features such as:

- large capacity, long distance and high efficiency power transmission;
- decrease of ROW per unit GW required for transferring;
- improvement of fault current conditions and system stability;
- possible reduction of environmental impact;
- reduction of transmission losses.

4.2 Key application issues

UHV AC transmission systems are capable of transmitting large amounts of electric power.

However, if a failure occurs in a UHV AC system, the system influence can be severe from the viewpoints of reliability and overall security of the supply of the power system. In particular, the UHV AC transmission systems design should be considered to improve lightning and switching protection performance.

In UHV AC transmission systems, typical phenomena depend on the length of the transmission line. For the phenomenon due to the long transmission line, reactive power issues such as voltage rise due to the Ferranti effect and geometrical mean distance for increasing surge impedance loading (SIL) should be taken into consideration. For high voltage issues, it is also necessary to take into consideration secondary arc extinction, temporary over-voltage (TOV) at load shedding, and DC time constant of short-circuit currents.

In addition, size and cost of equipment are large and the system design should aim at minimizing visual impact, construction and maintenance costs and transmission losses, and increasing the network connectivity by forecasting generation and load scenarios.

The history of the development of UHV AC transmission technologies is given in Annex A.

5 Required studies on UHV AC system planning and design

5.1 General

Early strategic system planning is conducted to meet the load growth and power source development planning. Once it is determined that a new transmission line is required in the system, preliminary economic feasibility study and project design begin.

During the term of the project design, three primary decisions should be addressed in a transmission-line project at the conceptual stage: capacity, voltage, and route.

Furthermore, strategic planning, as it relates to the environmental authorizations process, is often overlooked or viewed as being of secondary importance. Early strategic planning for the project-specific environmental review process can avoid significant effects on a project's schedule, costs, and ultimate success.

5.2 Required studies

The analytical studies can be divided into three types, corresponding to chronological phases of a project's planning, design, and implementation:

1) System planning study

In the planning stages, wherever new lines are needed, the voltage and current ratings, and major auxiliary equipment such as shunt compensation, are determined. At this stage, system contingencies are considered. Further studies need to be carried out for various power demand and generation scenarios, typical ones including peak demand, off peak demand for various seasons (summer, winter, rainy season), to check adequacy of the proposed transmission system. The basic study is a power flow calculation for which positive sequence parameters are adequate.

2) System impact study or detailed system design study

The impact of new planned transmission or generation on the power system should be evaluated by the system impact study. Based on the impact study, the high-level specification shall be determined. The system impact study may result in some adjustments, or mitigations applied to the system.

Study topics include harmonic resonance, short-circuit currents, transient stability, voltage stability, and system relaying. The study tools include short-circuit, stability, and harmonic analysis programmes, and in some cases an electromagnetic transient analytical programme to explore resonant overvoltages. The modelling needs to vary from lumped parameter to distributed parameter, from positive sequence to three-phase unbalanced representation, and from direct current to a few kHz, depending on the subject. Models are often generic in early studies, later progressing to specific models for particular equipment.

3) Equipment and system design study

Detailed protection and operating procedures for the switchgear, shunt compensation, and related equipment are established. The basic study tool is an electromagnetic transient analytical programme.

Accurate frequency dependent models are preferable and sometimes necessary for many of these studies.

5.3 Required analysis tools

The main considerations are power flow, fault current, voltage control, dynamic stability and operational criteria that include reliability and system security.

Once the high-level specification (number and type of conductors, voltage level, current rating, and reactive power compensation) has been determined, a more detailed design phase follows to specify equipment, such as circuit-breakers, shunt reactors, and surge arresters. No foreseeable problem should affect the reliable and safe operation of the system.

The analysis tool by time-domain is shown in Figure 1.

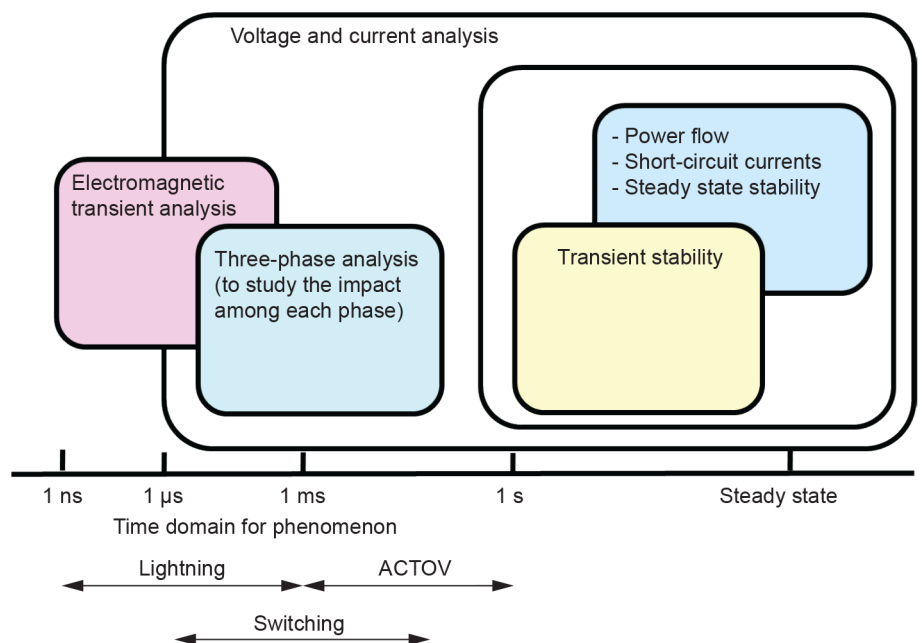


Figure 1 – Analysis tool by time domain

Line constants – a programme that calculates and represents electrical RLC parameters in a matrix form for a general system of tower and conductors, over a range of frequencies, and using either transposed or full unbalanced assumptions. This function may be bundled with another tool, or used separately.

Power flow – calculates steady-state voltages and currents based on a positive sequence model, with non-linear loads. The line model is symmetric and transposed. Power flow is the basic tool for transmission planning.

Short-circuit – a programme that solves voltage and current during faults, especially three-phase and single-phase-to-ground faults. The model is linear, symmetric, and assumes phase transposition. An auxiliary protection function simulates the response of relays to fault current and voltage.

Dynamics – a time-domain simulator based on numerical integration of differential equations. It differs from an electromagnetic transients programme (EMTP) as it focuses on (slower) electromechanical and control system transients, rather than electromagnetic transients. The models are sometimes linear and balanced. The programme usually includes eigenvalue analysis, or other functions for small-signal stability.

Harmonics – a frequency domain programme that solves voltage and current over a range of frequencies, using linear or non-linear load and source models, and balanced or unbalanced impedances. The frequency-scan function outputs driving point impedance, as obtained from the bus voltage for a unit current injection.

EMTP – a time-domain or transient simulator based on numerical integration of differential equations, including non-linear component models, unbalanced impedances, and frequency-dependent RLC parameters. An EMTP can also perform frequency scans, and may include an auxiliary programme of EMTP cable constants.

Electromagnetic field programme – a programme can compute electric and magnetic fields in the air and soil, as well as electric potentials, and the current distribution in the soil and in the conductors.

6 UHV AC system planning

6.1 General

6.1.1 Introductory remarks

Generally, the planning study process includes the following steps. As UHV AC system planning has specific requirements, some considerations are necessary for each step.

Experiences relating to UHV AC transmission development are given in Annex B.

6.1.2 Transmission capacity considering routes and line types to use

In the planning and design of power grid, increasing the voltage level of the transmission line to UHV not only increases the transmission capacity, but also reduces the cost of the transmission system and increases the corridor utilization rate of the transmission line.

The economic transmission distance of UHV transmission lines can be as much as 1 000 km to 1 500 km or even longer. The single line transmission capacity with 8 bundled wires can reach 12 000 MW. In the selection of UHV transmission capacity, the economic benefits of the entire power grid should be considered, rather than being limited to the economic benefits of a transmission line project.

6.1.3 Reactive power management issues

In the planning of the power system, the planning of reactive power supply and reactive power compensation facilities shall be included. In the engineering design of UHV AC transmission, the design of reactive power supply and reactive power compensation facilities should be carried out.

<https://standards.iteh.ai/catalog/standards/sist/80e5ab54-dc7e-4668-9df9-42d149ccc40e/iec-ts-63042-102-2021>

An appropriate amount of reactive power supply should be planned and installed in the UHV AC system to meet the system voltage regulation requirements and reduce the unintended reactive power transfer between different network nodes.

A sufficient amount of reactive power supply with flexible adjustable capacity, as well as reserve capacity of reactive power should be maintained.

The configuration of reactive power compensation and equipment type selection should be technically and economically compared.

Planning and design of the reactive power compensator for a UHV AC system should meet the overvoltage limiting requirement of UHV AC transmission systems.

The process of configuring reactive power compensation for a UHV AC system is as follows:

Step 1

Identify the range of likely active power flow across the UHV line, calculate and analyse the characteristics of reactive power and voltage profiles along the UHV line, taking into account the charging reactive power produced by UHV AC lines and reactive power loss under different power flows.

Step 2

Select the UHV transformer tap position to avoid overvoltage under a range of operating conditions taking into account UHV substation location, number of transmission lines connected, and system operation mode.