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CHANGE, E-WASTE, ENERGY EFFICIENCY;
CONSTRUCTION, INSTALLATION AND PROTECTION
OF CABLES AND OTHER ELEMENTS OF OUTSIDE
PLANT

Interfacing of renewable energy or distributed power sources to up to 400 VDC power feeding systems

Recommendation ITU-T L.1205

ITU-T L-SERIES RECOMMENDATIONS

**ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION,
INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT**

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Recommendation ITU-T L.1205

Interfacing of renewable energy or distributed power sources to up to 400 VDC power feeding systems

Summary

The up to 400 volt DC (VDC) power solutions feeding the power interface of ICT/telecom equipment as defined by the ITU-T L.1200 series, are well adapted to the straightforward use of renewable energy or distributed power sources through new simple direct current (DC) nano or micro grids. Recommendation ITU-T L.1205 defines the coupling of local or remote renewable energy into an up to 400 VDC power system without reducing DC performances defined in Recommendation ITU-T L.1202 mainly for efficiency and reliability. The main advantages are saving of fossil fuel (as a source of primary energy consumption), reduction of greenhouse gas (GHG) emissions and increased resilience. Additional site interconnection by a DC grid can even bring more optimization. One other big benefit is that compared to alternating current (AC), with 400 VDC there is no synchronization required between the various inputs, which keeps the architecture simple.

History

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FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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Introduction

The up to 400 VDC power feeding solution for ICT/telecom sites (data centres, telecommunication centres) and other building using the up to 400 VDC power interface defined in [ITU-T L.1200], are well adapted to straightforward use of renewable energy or distributed power sources through the new DC nano or micro grids, most of them being more complex in alternating current (AC) than in direct current (DC). The DC allows greater simplification by avoiding frequency and phase synchronisation of AC generators or inverters.

This Recommendation aims at defining the interface and architecture for injecting renewable energy into an up to 400 VDC power system charged with providing power to telecom/ICT and facilities equipment with an interface compliant to that defined in [ITU-T L.1200] and with a DC power architecture as defined in [b-ITU-T L.1204], without reducing DC performances defined in [ITU-T L.1202] mainly for efficiency and reliability.

The addition of local renewable energy will reduce energy consumption from the public utility and possibly fossil fuel primary energy consumption as well as the corresponding high greenhouse gas (GHG) emissions.

Local renewable energy can also provide more resilience in case of public electric grid interruption.

In addition, energy exchange is simple with distributed green power sources such as photovoltaic (PV), wind power, fuel cells or engine generators using green fuel, through DC nano or micro grids at the level of a multi-building site or between different sites. These sites can be any type of information and communication technology (ICT) sites such as network access or nodes, data centres, customer premises including IoT devices, etc.). Such an inter-buildings or sites power interconnection is called a 'site grid' as opposed to a public electric utility.

These DC energy exchanges through site grids can provide a higher level of optimisation through:

- exploiting green-energy sources more efficiently by the optimal location of renewable energy generators (e.g., at windy sites or sites with low levels of sunlight)
- complementing local back-up power systems e.g., battery power
- sharing local renewable energy excesses of one site with other sites
- ensuring remote powering of distributed ICT sites in the neighbourhood (e.g., by dedicated remote DC power cables or hybrid optical and DC power cables)

Injection of renewable energy into a legacy AC public utility irrespective of the use will lead to a greener use of electricity for ICT services, by avoiding undetermined use in the neighbourhood that may be inefficient. This could be precisely accounted for in key indicators on renewable energy use in one site or inter sites through a nano grid.

Many of the documents listed in the bibliography elaborate on the benefits and need of coupling local renewable energy (REN) [b-greenstar], [b-Emerson DC REN] or nano grids [b-huawei] to ICT installations and the advantages of doing so in DC [b-Vicor Stephen], [b-Starline], [b-Emerson Case Study]. The life cycle assessment (LCA) approach is described in more detail in [b-ecodesigned DC].

This Recommendation was developed jointly by the European Telecommunications Standards Institute (ETSI) and ITU-T Study Group 5 and published respectively by ITU-T and ETSI as Recommendation ITU-T L.1205 and ETSI Standard ETSI ES 203 474, which are technically equivalent.

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Recommendation ITU-T L.1205

Interfacing of renewable energy or distributed power sources to up to 400 VDC power feeding systems

1 Scope

This Recommendation defines the interconnection of the site power installation feeding an up to 400 VDC interface, to site renewable energy or to distributed DC power sources. The aspects covered include:

- general power architectures for:
 - connection of a site renewable energy source (PV, wind generator, fuel cells, etc.) to a site power plant and especially to a DC power system, (the site sources being on the buildings or around)
 - exchange of power to and from a DC nano or micro grid for use and production outside of the site (this includes dedicated remote powering networks built for telecom/ICT access equipment but also more general purpose DC electric grids)
- conditions required to maintain the specified performance for the up to 400V power system:
 - electrical stability
 - reliability and maintainability
 - proper battery charge and management
 - lightning protection coordination
 - electromagnetic compatibility (EMC) and transient limits
- specification of proper power sizing (requirements for control-monitoring and power metering)
- assessment of performances (AC grid energy saving, reliability, flexibility, environmental impact, etc.)

The current Recommendation does not cover:

- renewable energy dimensioning
- power injection into the legacy AC utilities which is already covered by many Standards (e.g., IEC Standards),
- some of the smart power management possibilities through exchanges with DC nano or micro grids

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T L.1200] Recommendation ITU-T L.1200 (2012), *Direct current power feeding interface up to 400 V at the input to telecommunication and ICT equipment.*

[ITU-T L.1202]	Recommendation ITU-T L.1202 (2015), <i>Methodologies for evaluating the performance of up to 400 VDC power feeding system and its environmental impact.</i>
[ITU-T L.1203]	Recommendation ITU-T L.1203 (2016), <i>Colour and marking identification of up to 400 VDC power distribution for information and communication technology systems.</i>
[ETSI EN 301 605]	ETSI EN 301 605 V1.1.1 (2013), <i>Environmental Engineering (EE); Earthing and bonding of 400 VDC data and telecom (ICT) equipment.</i>
[ETSI ES 202 336-X]	ETSI ES 202 336 series (in force), <i>Environmental Engineering (EE); Monitoring and Control Interface for Infrastructure Equipment (Power, Cooling and Building Environment Systems used in Telecommunication Networks).</i>
[IEC 60364-1]	IEC 60364-1:2005, <i>Low-voltage electrical installations – Part 1: Fundamental principles, assessment of general characteristics, definitions.</i>
[IEC 62368-1]	IEC 62368-1:2014, <i>Audio/video, information and communication technology equipment – Part 1: Safety requirements.</i>

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 interface P [ITU-T L.1200]: Interface, physical point, at which a power feeding system is connected to operate ICT equipment.

3.1.2 ICT equipment [ITU-T L.1200]: Information and communication equipment (e.g., switch, transmitter, router, server and peripheral devices) used in telecommunication centres, data-centres and customer premises.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 back-up power system: Power system providing energy to equipment of an ICT/telecom site in case of downstream electrical power unavailability.

3.2.2 distributed power source: A local electrical power source where energy is produced close to the user and distributed by a nano or micro grid as opposed to a centralized power plant with a long distance electricity transport grid. This local power source can be an individual user power system or a small collective energy power plant for a group of customers. It can include energy sources or storage or cogeneration of heat and electricity using any primary energy, renewable or not.

3.2.3 distributed power system: A system of distributed power sources and possibly other functions such as energy conversion, interconnection, safety systems, energy storage and corresponding management.

3.2.4 renewable energy: This is mainly non-fossil fuel converted into electricity (e.g., solar energy, wind, water flow, biomass) which can be obtained from natural resources that can be constantly replenished. (Based on the definitions provided in [b-ITU-T L.1204] and [b-Arena])

3.2.5 renewable energy source: Source producing electrical energy from renewable energy.