PD IEC TR 61850-90-9:2020

BSI Standards Publication

Communication networks and systems for power utility automation

Part 90-9: Use of IEC 61850 for Electrical Energy Storage Systems

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National foreword

This Published Document is the UK implementation of IEC TR 61850-90-9:2020.

The UK participation in its preparation was entrusted to Technical Committee PEL/57, Power systems management and associated information exchange.

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TECHNICAL REPORT

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Communication networks and systems for power utility automation – Part 90-9: Use of IEC 61850 for Electrical Energy Storage Systems

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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FOREWORD

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IEC 61850-90-9, which is a technical report, has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

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

Enquiry draft	Report on voting
57/2128/DTR	57/2184/RVDTR

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

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

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A list of all parts in the IEC 61850 series, published under the general title *Communication networks and systems for power utility automation*, can be found on the IEC website.This IEC standard includes Code Components i.e. components that are intended to be directly processed by a computer.

Such content is any text found between the markers <CODE BEGINS> and <CODE ENDS>, or otherwise is clearly labelled in this standard as a Code Component.

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Table 1 shows all tracking information of (Tr)IEC 61850-90-9:2018A namespace building-up

Table 1 – Tracking information of (Tr)IEC 61850-90-9:2018A namespace building-up

Attribute	Content
Namespace IEC specific information	
Version of the UML model used for generating the document (informative)	WG17build6
Date of the UML model used for generating the document (informative)	2020-05-19
Autogeneration software name and version(informative)	j61850DocBuilder 01v03 based on jCleanCim 02v02-NS beta6

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.

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INTRODUCTION

IEC 61850 consists of the following parts, under the general title *Communication networks and systems for power utility automation* (all parts may have not been published yet).

Part 1: Introduction and overview

Part 2: Glossary

Part 3: General requirements

Part 4: System and project management

Part 5: Communication requirements for functions and device models

Part 6: Configuration description language for communication in electrical substations related to IEDs

Part 7-1: Basic communication structure – Principles and models

Part 7-2: Basic communication structure – Abstract communication service interface (ACSI)

Part 7-3: Basic communication structure – Common data classes

Part 7-4: Basic communication structure – Compatible logical node classes and data classes

Part 7-410: Hydroelectric power plants – Communication for monitoring and control

Part 7-420: Basic communication structure – Distributed energy resources logical nodes

Part 8-1: Specific communication service mapping (SCSM) – Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3

Part 80-1: Guideline to exchange information from a CDC based data model using IEC 60870-5-101/104

Part 9-2: Specific communication service mapping (SCSM) – Sampled values over ISO/IEC 8802-3

Part 90-1: Use of IEC 61850 for the communication between substations

Part 90-2: Using IEC 61850 for the communication between substations and control centres

Part 90-3: Using IEC 61850 for condition monitoring

Part 90-4: Network Engineering Guidelines – Technical report

Part 90-5: Using IEC 61850 to transmit synchrophasor information according to IEEE C37.118

Part 90-7: Object models for power converters in distributed energy resources (DER) systems

Part 90-8: Object model for E-mobility

Part 90-10: Object model for scheduling

Part 10: Conformance testing

In addition to the above, the IEC 61850 basic communication structure for Wind Turbines has been published as IEC 61400-25, *Wind turbines – Communications for monitoring and control of wind power plants*.

This technical report is primarily based on the recommendation 5.7.4. “interface, control and standard data elements”, of the IEC white paper ”Electrical Energy Storage” published in December 2011 by the MSB. The recommendation proposes the necessity of a standardization of interfaces between storage and other grid elements, protocols for data exchange and control rules, and data elements for input, output and control information supplied by or to storage systems. In Chapter 5 of the white paper “Large Capacity EESS”, EESS systems are expected to play an important role in integrating renewable energy by providing flexibility for the grid.

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This document also describes the basic functions of Electric Energy Storage System (EESS) and the information model of the interface to integrate EESS in intelligent grids and establish the necessary communication with standardised data objects.

This document is connected with IEC 61850-7-420 Edition 2[1], as well as IEC 61850-7-4:2010 and IEC 61850-7-4/AMD1:2015, explaining how the control system and other functions in a battery based electric energy storage unit utilizes logical nodes and information exchange services within the IEC 61850 framework to specify the information exchanged between functions as well as information that individual functions need and generate. IEC 61850-7-420:2009 provides an information model for batteries which was derived from the proposed data objects of part 7-4. Those data objects (as well as the models proposed within IEC TR 61850-90-3) follow the requirements of batteries that are supposed to be used in substations as an auxiliary power system and as backup power supplies. For this purpose, it was enough to only model the discharge function. Therefore, it is necessary to prepare new logical nodes to be applicable for grid connected electrical energy storage systems, i.e. the scope of this technical report.

This document provides necessary information within the IEC 61850 based object model in order to model functions of a battery based electrical energy storage system as a DER unit. For intelligently operated and/or automated grids, storing energy for optimising the grid operation is a core function. Therefore, shorter periods of storing energy with charging and discharging capability are also an indispensable function. Charging and discharging operations need to be modelled thoroughly and are in the focus of this technical report.

Once agreed, the content of this report is intended to be merged within a new edition of IEC 61850-7-420. In order to facilitate such merge, this document already mentions by anticipation some elements extracted from a forthcoming second edition of IEC 61850-7-420, and which appear to be key to guarantee the consistency between the future DER model proposed in the forthcoming second edition of IEC 61850-7-420 and the detailed electrical energy storage system model, presented in this document.

These elements are specifically tagged as “referring to the forthcoming second edition of IEC 61850-7-420” and should be updated as soon as this new edition is officially published.

This document has also been worked upon in order to be as close as possible to the forthcoming IEC 62933 series[2].

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1 Under preparation. Stage at the time of publication: IEC/PRVC 61850-7-420:2020.

2 Under consideration.

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COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

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1 Scope

1.1 Scope of this document

This technical report, which is part of the IEC 61850 series, describes the IEC 61850 information model for electrical energy storage systems (EESS). Therefore, this document only focuses on storage functionality in the purpose of grid integration of such systems at the DER unit level. Higher level Interactions are already covered in IEC 61850-7-420.

1.2 Namespace

This new subclause is mandatory for any IEC 61850 namespace (as defined by IEC 61850-7-1/AMD1).

Table 2 shows all attributes of (Tr)IEC 61850-90-9:2018A namespace.

Table 2 – Attributes of (Tr)IEC 61850-90-9:2018A namespace

Attribute	Content
Namespace nameplate	
Namespace Identifier	(Tr)IEC 61850-90-9
Version	2018
Revision	A
Release	3
Full Namespace Name	(Tr)IEC 61850-90-9:2018A
Namespace Type	transitional
Namespace dependencies	
Extends	IEC 61850-7-420:2019A version :2019 revision :A
Namespace transitional status	
Future handling of namespace content	The name space (Tr)IEC 61850-90-9:2018A is considered as "transitional" since the models are expected to be included in further editions IEC 61850-7-4xx. Potential extensions/modifications may happen if/when the models are moved to the International Standard status

1.3 Data model Namespace Code Component distribution

The Code Components are in light and full version:

- The full version is named: *IEC_TR_61850-90-9.NSD.2018A.Full*. It contains definition of the whole data model defined in this standard with the documentation associated and access is restricted to purchaser of this part.
- The light version is named: *IEC_TR_61850-90-9.NSD.2018A.Light*. It does not contain any documentations but contains the whole data model as per full version, and this light version is freely accessible on the IEC website for download at: http://www.iec.ch/tc57/supportdocuments, but the usage remains under the licensing conditions.

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The Code Components for IEC 61850 data models are formated in compliance with the NSD format defined by the standard IEC 61850-7-7. Each Code Component is a ZIP package containing:

- the electronic representation of the Code Component itself (possibly multiple files),
- the grammar files (XSD) enabling to check the consistency of the associated files against the defined version of NSD, but as well against the IEC 61850 flexibility rules in case of private extensions,
- a file describing the content of the package (IECManifest.xml).

The IECManifest contains different sections giving information on:

- The copyright notice
- The identification of the code component
- The publication related to the code component
- The list of the electronic files which compose the code component
- An optional list of history files to track changes during the evolution process of the code component.

The life cycle of a code component is not restricted to the life cycle of the related publication. The publication life cycle goes through two stages, Version (corresponding to an edition) and Revision (corresponding to an amendment). A third publication stage (Release) allows publication of Code Component in case of urgent fixes of InterOp Tissues, thus without need to publish an amendment.

Consequently new release(s) of the Code Component may be released, which supersede(s) the previous release, and will be distributed through the IEC TC57 web site at: http://www.iec.ch/tc57/supportdocuments.

The latest version/release of the document will be found by selecting the file named *IEC_TR_61850-90-9.NSD.{VersionStateInfo}.Light* with the filed VersionStateInfo of the highest value.

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 TS 61850-2, *Communication networks and systems for power utility automation - Part 2: Glossary*

IEC 61850-7-2:2010, *Communication networks and systems for power utility automation - Part 7-2: Basic information and communication structure - Abstract communication service interface (ACSI)*
IEC 61850-7-2:2010/AMD1:2020

IEC 61850-7-3:2010, *Communication networks and systems for power utility automation - Part 7-3: Basic communication structure - Common data classes*
IEC 61850-7-3:2010/AMD1:2020

IEC 61850-7-4:2010, *Communication networks and systems for power utility automation - Part 7-4: Basic communication structure - Compatible logical node classes and data object classes*

IEC 61850-7-4:2010/AMD1:2020

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IEC 61850-7-420, *Communication networks and systems for power utility automation – Part 7-420: Basic communication structure – Distributed energy resources logical nodes*[3]

IEC TS 62933-3-1, *Electrical energy storage (EES) systems - Part 3-1: Planning and performance assessment of electrical energy storage systems - General specification*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC TS 62933-3-1, IEC TS 61850-2, IEC 61850-7-2 and IEC 61850-7-420, as well as the following, 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

3.1.1
Actual Power Capability (includes Emergency mode)
value of power at a given time considering as a result of temperature or other factors

3.1.2
Actual State of Charge of an EESS
relation between the available energy from an EESS and the actual energy capacity, expressed as a percentage of the actual energy capacity

3.1.3
available energy
maximum electrical energy that can be extracted from the EESS system from the current state of charge of the EEES system

Note 1 to entry: Joule (J) is the base unit, other units may be chosen for convenience as well (kWh, MWh).

Note 2 to entry: Depending on the technology used, the available energy can differ by ambient temperature, self-discharge, power conversion losses, c-rate (for batteries) and other factors.

[SOURCE: IEC 62933-1:2018]

3.1.4
controllable load
load whose energy consumption may be increased or decreased through control actions by other entities

Note 1 to entry: “Controllable load” and “load” are considered equivalent in this document.

3.1.5
distributed energy resource
DER
generation, storage, and controllable load connected at the low or medium voltage distribution level

Note 1 to entry: DER may include associated protection, control, and monitoring capabilities, and may consist of aggregated DER units.

[3] Under preparation. Stage at the time of publication: IEC/PRVC 61850-7-420:2020.

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Note 2 to entry: DER may also interact with the distribution network by providing energy to the distribution network, by adapting their behaviour based on distribution network conditions, and/or by providing other transmission and distribution network-related services.

3.1.6
distributed energy resource (DER) unit
DER unit
individual DER device inside a group of DER that collectively form a system

3.1.7
distributed energy resource (DER) system
DER system
collection of DER Units

3.1.8
effective actual energy capacity
EESS system energy capacity at a given time as a result of a degraded state of health and other factors

3.1.9
emergency energy capacity
EESS system energy capacity at a given time which can be used under emergency condition with potential risk to the asset (health)

3.1.10
emergency power capability
assigned value of the power in emergency conditions

3.1.11
rated energy capacity
nameplate energy capacity
assigned value of the energy content of the EESS system in continuous operating conditions, starting from a full state of charge and discharging continuously at rated active power, measured at the primary POC

3.1.12
rated power capability
nameplate power capability
assigned value of the power in operating conditions measured at the primary PCC

3.1.13
state of charge of an EESS
relation between the available energy from an EESS and the actual energy capacity, typically expressed as a percentage

3.1.14
state of total usable charge of an EESS
relation between the available energy from an EESS and the total usable energy capacity, expressed as a percentage of the total usable energy capacity

3.1.15
state of usable charge of an EESS
(per user) relation between the available energy from an EESS and the usable energy capacity, expressed as a percentage of the usable energy capacity

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3.1.16
total usable energy capacity
energy capacity that all users are permitted to have access to, computed (in the simplest case just summing up) usable energy capacity out of those of the corresponding group of EESS, based on the decisions of EESS manufacturers or EESS owner/operators

3.1.17
usable energy capacity (split)
energy that each user is permitted to have access to, which is based on the decisions of EESS manufacturers or EESS owner/operators

3.1.18
usable power capability
power capability which it is permitted to set, which is based on the decisions of EESS manufacturers or EESS owner/operators

3.1.19
usable energy capacity (split)
energy capacity that each user is permitted to hvae access to, which is based on the decisions of EESS manufacturers or EESS owner/operators

3.2 Abbreviated terms

Table 3 presents generic acronyms and abbreviated terms used throughout this document.

Table 3 – Generic acronyms and abbreviated terms

DER	Distributed Energy Resource
DER MS	DER Management System
DERCtl	DER Unit Controller
DSO	Distribution System Operator
ECP	Electrical Connection Point
EPS	Electrical Power System
EESS	Electrical Energy Storage System
FDEMS	Facility DER Energy Management System
IED	Intelligent Electronic Device
PCC	Point of Common Coupling
SoC	State of Charge
TSO	Transmission System Operator
VPP	Virtual Power Plant

3.3 Acronyms and abbreviated terms proposed specifically for the data model part of this document

Table 4 shows normative terms that are combined to create data object names.

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Table 4 – Normative abbreviations for data object names

Term	Description
Cea	Cease
Eff	Effective
Engz	Energize
Mx	Maximum
Rnt	Round trip
Rtn	Return
Soh	state of health
Trn	Turn

3.4 Common abbreviated terms used for the data model part of this document

(Extract from IEC 61850-7-4:2010/AMD1:2020 and partly used in this document).

Table 5 shows normative terms that are combined to create data object names.

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Table 5 – Normative abbreviations for data object names

Term	Description
A	Current; phase A (L1)
AC	AC, alternating current
AGC	Automatic generation control
ASG	Analogue setting CDC
AWatt	Wattmetric component of current
Abr	Abrasion
Abs	Absolute
Absb	Absorbing
Acc	Accuracy; acceleration (deprecated: use Accl instead)
Accl	Acceleration
Accm	Accumulated
Ack	Acknowledgement, acknowledge
Acs	Access
Act	Action, activity, active, activate
Actr	Actuator
Acu	Acoustic
Addr	Address
Adj	Adjustment
Admin	Administrative
Adp	Adapter, adaptation
Aff	Affected
Age	Ageing
Ahr	Ampere hours
Air	Air
Alg	Algorithm
Alm	Alarm, alarm trigger status
Als	Alarm trigger status set
Alt	Altitude
Altn	Alternate
Amnt	Amount
Amp	Ampere, current DC or non-phase-related AC
An	Analogue
Anc	Ancillary
Ane	Anemometer
Ang	Angle
Ap	Access point
Apc	Analogue point control
App	Apparent
Ar	Amperes reactive (reactive current)
Arc	Arc
Area	Area
Arr	Array
Asyn	Asynchronous
At	At
Auth	Authorisation
Auto	Automatic
Aux	Auxiliary
Av	Average
Avl	Availability
Ax	Axial
Azi	Azimuth
B	Bushing; phase B (L2)

Documents
Document Sharing Hub

Term	Description
BG	Before Gain
Bac	Binary-controlled analogue value
Bar	Barrier
Base	Base
Bat	Battery
Bck	Backup
Bec	Beacon
Beh	Behaviour
Ber	Bit error rate
Bias	Bias
Bl	Blade
Blb	Bulb
Blk	Block, blocked
Blow	Blowby
Bnd	Band, bandwidth
Boil	Boiler
Bot	Bottom
Brcb	Buffered report control block
Brg	Bearing
Brk	Brake
Bsc	Binary status control
Bst	Boost
Bt	Heartbeat
Bub	Bubbling
Bus	Bus
Byp	Bypass
C	Carbon; phase C (L3)

Term	Description
C2H2	Acetylene
C2H4	Ethylene
C2H6	Ethane
CB	Circuit breaker
CE	Cooling equipment (see also Cl)
CG	Core ground
CH4	Methane
CHP	Combined heat and power
CO	Carbon monoxide
CO2	Carbon dioxide
Cab	Cable
Cal	Calorie, caloric
Cam	Cam, e.g. rotating non-circular disk
Can	Cancel
Cap	Capability, capacity
Capac	Capacitance
Car	Carrier
Cbr	Calibration
Ccw	Counter clockwise
Ccy	Currency
Cds	Condensation
Ceil	Ceiling
Cel	Cell
Cf	Crest factor
Cff	Coefficient
Cfg	Configuration
Cg	Combusted Gas

Documents
Document Sharing Hub
Full document details: PD IEC TR 61850-90-9:2020

Term	Description
Ch	Channel
Cha	Charger
Chg	Change
Chk	Check
Chr	Characteristic
Chs	Chassis
Circ	Circulating, circuit
Cl	Cooling, coolant, cooling system (see also CE)
Clc	Calculate, calculated
Clip	Clip
Clk	Clock
Cloud	Cloud
Clr	Clear
Cls	Close, closed
Cm	Centimetres
Cmbu	Combustible, combustion
Cmd	Command
Cmpl	Completed, completion, complete
Cmut	Commute, commutator
Cndct	Conductivity, Conducting
Cnt	Counter
Cntt	Contractual
Cnv	Converter
Col	Coil
Comm	Communication
Comp	Compensation
Conf	Configuration

Term	Description
ConfRev	Configuration revision (confRev from IEC 61850-7-2)
Conn	Connected, connections
Cons	Constant (general)
Cor	Correction
Core	Core
Cost	Cost
Crank	Crank
Crd	Coordination
Crit	Critical
Crl	Correlation
Crp	Creeping, slow movement
Crv	Curve
Csmp	Consumption, consumed
Ctl	Control
Ctr	Center
Cum	Cumulative
Cur	Current
Cut	Cut, cut-out, cut-in
Cvr	Cover, cover level
Cw	Clockwise
Cwb	Crowbar
Cyc	Cycle
D	Derivate
DC	DC, direct current
DER	Distributed energy resource
DExt	De-excitation
DPCSO	Double point controllable status output

Documents
Document Sharing Hub
Full document details: PD IEC TR 61850-90-9:2020

Term	Description
DQ0	Direct, quadrature, and zero axis quantities
DS	Device state
DT	Daylight saving time
Dam	Dam
Damp	Damping
Date	Date, date and time of action
Day	Day
Db	Deadband
Dcl	DC-link
Dct	Direct
De	De (prefix)
Dea	Dead
Dec	Decrease
Deg	Degrees
Dehum	De-humidifier
Del	Delta
Den	Density
Dep	Dependent
Desc	Description
Det	Detected
Detun	Detuning
Dev	Device
Dew	Dew
Dff	Diffuse
Dfl	Deflector (used in Pelton turbines)
Dft	Default
Dia	Diaphragm

Term	Description
Diag	Diagnostics
Dif	Differential, difference
Dig	Digital
Dip	Dip
Dir	Direction
Dis	Distance
Dist	Distribution
Dith	Dither
Dl	Delay
Dlt	Delete
Dlv	Delivery
Dmd	Demand
Dn	Down, downstream
Dpc	Double point control
Dpt	Departure
Drag	Drag hand
Dropout	Dropout
Drp	Droop
Drt	Derate
Drtb	Draft tube
Drv	Drive
Dsa	Disable, disabled
Dsc	Discrepancy
Dsch	Discharge
Dscon	Disconnected
Dsp	Displacement
Dtc	Detection

Documents
Document Sharing Hub
Full document details: PD IEC TR 61850-90-9:2020

Term	Description
Dur	Duration
Dust	Dust
Dv	Deviation
Dw	Delta Omega
Dyn	Dynamic
EE	External equipment
EF	Earth fault
EFN	Earth-fault neutraliser (Petersen coil)
EMA	E-mobility Account
ENG	Enumerated status setting CDC
ENS	Enumerated status CDC
EPC	Emergency Power Control
EV	Electrical Vehicle
EVSE	EV Supply Equipment
Echo	Echo
Ecp	Electrical connection point
Edt	Edit, edited
Efc	Efficiency
El	Elevation
Ela	Elasticity
Em	Emission
Emg	Emergency
En	Energy
Ena	Enabled, enable, allow operation
Enc	Enumerated control
Encl	Enclosure
End	End

Term	Description
Eng	Engine
Ent	Entity, entities
Entr	Entry, entries
Env	Environment
Eq	Equalization, equal, equivalent
Err	Error
Est	Estimated
Ev	Evaluation
Evn	Even
Evt	Event
Ex	External
ExIm	Export/import
Exc	Exceeded
Excl	Exclusion
Exp	Expired
Exps	Expansion
Expt	Export
Ext	Excitation
F	Float
FA	Fault arc
FPM	Fuel processing module
Fa	"Fire all" sequence (to thyristors)
Fact	Factor
Fail	Failure
Fan	Fan
Fbc	Field breaker configuration
Fer	Frame error rate

Documents
Document Sharing Hub
Full document details: PD IEC TR 61850-90-9:2020

Term	Description
Fil	Filter, filtration system
Fire	Fire
Fish	Fish
Fix	Fixed
Fld	Field
Flk	Flicker
Fll	Fall
Flm	Flame
Flood	Flood
Flsh	Flash, flashing
Flt	Fault
Flush	Flush
Flw	Flow, flowing
Fol	Follower, following
Forc	Forced
Fu	Fuse
Fuel	Fuel
Full	Full
Fun	Function
Fwd	Forward
Gain	Gain
Gas	Gas
Gbx	Gearbox
Gdv	Guide vane
Gen	General
Glob	Global
Gm	Grand master

Term	Description
Gn	Generator
Gnd	Ground
GoCBRef	GOOSE control block reference
Gocb	GOOSE control block
Gr	Group
Gra	Gradient
Grd	Guard
Gri	Grid
Gross	Gross
Gs	Grease
Gte	Gate
Gust	Gust
H	Harmonics (phase-related)
H2	Hydrogen
H2O	Water (chemical aspect: liquid, steam, etc.)
HP	Hot point
HPh	Harmonics phase
Ha	Harmonics (non-phase-related AC)
Har	Harmonic
Hb	Harmonic bin
Hd	Head
Health	Health
Heat	Heater, heating, heat (see also Ht)
Hello	Hello signal, Live signal, "I am alive" signal
Hi	High, highest
Hlf	Half
Hold	Hold

Documents
Document Sharing Hub
Full document details: PD IEC TR 61850-90-9:2020

Term	Description
Hor	Horizontal
Horn	Horn
Ht	Heating, heating system (see also Heat)
Htex	Heat-exchanger
Hub	Hub
Hum	Humidity
Hy	Hydraulic, hydraulic system
Hyd	Hydrological, hydro, water
Hys	Hysteresis
Hz	Frequency
Hz1	Frequency at side 1
Hz2	Frequency at side 2
I	Integral, integration
ING	Integer status setting CDC
INS	Integer status CDC
ISCSO	Integer status controllable status output
Ia	Information available
Iafm	Information available force majeure
Iano	Information available non-operative
Ianofo	Information available non-operative forced outage
Ianopca	Information available non-operative planned corrective action
Ianos	Information available non-operative suspended
Ianosm	Information available non-operative scheduled maintenance
Iao	Information available operative
Iaog	Information available operative generating
Iaogfp	Information available operative generating with full performance
Iaogpp	Information available operative generating with partial performance

Term	Description
Iaong	Information available operative non-generating
Iaongel	Information available operative non-generating out of electrical specification
Iaongen	Information available operative non-generating out of environment specification
Iaongrs	Information available operative non-generating requested shutdown
Iaongts	Information available operative non-generating technical standby
Ice	Ice
Id	Identity, identifier
Ieee	IEEE definition
IeeeKH	Proportional gain HF (High Frequency). Defined in IEEE 421.5
IeeeKH1	Proportional gain HF positive. Defined in IEEE 421.5
IeeeKH11	Lead gain HF positive. Defined in IEEE 421.5
IeeeKH17	Lead gain HF negative. Defined in IEEE 421.5
IeeeKH2	Proportional gain HF negative. Defined in IEEE 421.5
IeeeKI	Proportional gain IF (Intermediate Frequency). Defined in IEEE 421.5
IeeeKI1	Proportional gain IF positive. Defined in IEEE 421.5
IeeeKI11	Lead gain IF positive. Defined in IEEE 421.5
IeeeKI17	Lead gain IF negative. Defined in IEEE 421.5
IeeeKI2	Proportional gain IF negative. Defined in IEEE 421.5
IeeeKL	Proportional gain LF (Low Frequency). Defined in IEEE 421.5
IeeeKL1	Proportional gain LF positive. Defined in IEEE 421.5
IeeeKL11	Lead gain LF positive. Defined in IEEE 421.5
IeeeKL17	Lead gain LF negative. Defined in IEEE 421.5
IeeeKL2	Proportional gain LF negative. Defined in IEEE 421.5
IeeeKs1	Gain Ks1. Defined in IEEE 421.5
IeeeKs2	Gain Ks2. Defined in IEEE 421.5
IeeeKs3	Gain Ks3. Defined in IEEE 421.5

Documents
Document Sharing Hub
Full document details: PD IEC TR 61850-90-9:2020

Term	Description
IeeeM	Ramptrack lowpass degree M. Defined in IEEE 421.R
IeeeN	Ramptrack overall degree N. Defined in IEEE 421.5
IeeeT1	Time constant T1. Defined in IEEE 421.5
IeeeT10	Time constant T10. Defined in IEEE 421.5
IeeeT11	Time constant T11. Defined in IEEE 421.5
IeeeT2	Time constant T2. Defined in IEEE 421.5
IeeeT3	Time constant T3. Defined in IEEE 421.5
IeeeT4	Time constant T4. Defined in IEEE 421.5
IeeeT7	Time constant T7. Defined in IEEE 421.5
IeeeT8	Time constant T8. Defined in IEEE 421.5
IeeeT9	Time constant T9. Defined in IEEE 421.5
IeeeTH1	Time constant TH1 (High frequency positive). Defined in IEEE 421.5
IeeeTH10	Time constant TH10 (High frequency negative). Defined in IEEE 421.5
IeeeTH11	Time constant TH11 (High frequency negative). Defined in IEEE 421.5
IeeeTH12	Time constant TH12 (High frequency negative). Defined in IEEE 421.5
IeeeTH2	Time constant TH2 (High frequency positive). Defined in IEEE 421.5
IeeeTH3	Time constant TH3 (High frequency positive). Defined in IEEE 421.5
IeeeTH4	Time constant TH4 (High frequency positive). Defined in IEEE 421.5
IeeeTH5	Time constant TH5 (High frequency positive). Defined in IEEE 421.5
IeeeTH6	Time constant TH6 (High frequency positive). Defined in IEEE 421.5
IeeeTH7	Time constant TH7 (High frequency negative). Defined in IEEE 421.5
IeeeTH8	Time constant TH8 (High frequency negative). Defined in IEEE 421.5
IeeeTH9	Time constant TH9 (High frequency negative). Defined in IEEE 421.5

Term	Description
IeeeTI1	Time constant TI1 (Intermediate frequency positive). Defined in IEEE 421.5
IeeeTI10	Time constant TI10 (Intermediate frequency negative). Defined in IEEE 421.5
IeeeTI11	Time constant TI11 (Intermediate frequency negative). Defined in IEEE 421.5
IeeeTI12	Time constant TI12 (Intermediate frequency negative). Defined in IEEE 421.5
IeeeTI2	Time constant TI2 (Intermediate frequency positive). Defined in IEEE 421.5
IeeeTI3	Time constant TI3 (Intermediate frequency positive). Defined in IEEE 421.5
IeeeTI4	Time constant TI4 (Intermediate frequency positive). Defined in IEEE 421.5
IeeeTI5	Time constant TI5 (Intermediate frequency positive). Defined in IEEE 421.5
IeeeTI6	Time constant TI6 (Intermediate frequency positive). Defined in IEEE 421.5
IeeeTI7	Time constant TI7 (Intermediate frequency negative). Defined in IEEE 421.5
IeeeTI8	Time constant TI8 (Intermediate frequency negative). Defined in IEEE 421.5
IeeeTI9	Time constant TI9 (Intermediate frequency negative). Defined in IEEE 421.5
IeeeTL1	Time constant TL1 (Low frequency positive). Defined in IEEE 421.5
IeeeTL10	Time constant TL10 (Low frequency negative). Defined in IEEE 421.5
IeeeTL11	Time constant TL11 (Low frequency negative). Defined in IEEE 421.5
IeeeTL12	Time constant TL12 (Low frequency negative). Defined in IEEE 421.5
IeeeTL2	Time constant TL2 (Low frequency positive). Defined in IEEE 421.5
IeeeTL3	Time constant TL3 (Low frequency positive). Defined in IEEE 421.5
IeeeTL4	Time constant TL4 (Low frequency positive). Defined in IEEE 421.5

AVA Documents
Document Sharing Hub
Full document details: PD IEC TR 61850-90-9:2020

Term	Description
IeeeTL5	Time constant TL5 (Low frequency positive). Defined in IEEE 421.5
IeeeTL6	Time constant TL6 (Low frequency positive). Defined in IEEE 421.5
IeeeTL7	Time constant TL7 (Low frequency negative). Defined in IEEE 421.5
IeeeTL8	Time constant TL8 (Low frequency negative). Defined in IEEE 421.5
IeeeTL9	Time constant TL9 (Low frequency negative). Defined in IEEE 421.5
IeeeTw1	Time constant wash out Tw1. Defined in IEEE 421.5
IeeeTw2	Time constant wash out Tw2. Defined in IEEE 421.5
IeeeTw3	Time constant wash out Tw3. Defined in IEEE 421.5
IeeeTw4	Time constant wash out Tw4. Defined in IEEE 421.5
IeeeVHMax	Maximum limit set-point HF. Defined in IEEE 421.5
IeeeVHMin	Minimum limit set-point HF. Defined in IEEE 421.5
IeeeVIMax	Maximum limit set-point IF. Defined in IEEE 421.5
IeeeVIMin	Minimum limit set-point IF. Defined in IEEE 421.5
IeeeVLMax	Maximum limit set-point LF. Defined in IEEE 421.5
IeeeVLMin	Minimum limit set-point LF. Defined in IEEE 421.5
IeeeVsi1Max	Input High Limit 1. Defined in IEEE 421.5
IeeeVsi1Min	Input Low Limit 1. Defined in IEEE 421.5
IeeeVsi2Max	Input High Limit 2. Defined in IEEE 421.5
IeeeVsi2Min	Input Low Limit 2. Defined in IEEE 421.5
IeeeVstMax	Output High Limit. Defined in IEEE 421.5
IeeeVstMin	Output Low Limit. Defined in IEEE 421.5
Imb	Imbalance
Imp	Impedance non-phase-related AC
Impact	Impact
Impt	Import
In	Input
Ina	Inactivity

Term	Description
Inc	Integer control
Incl	Inclination
Incr	Increment, increase
Ind	Indication
Indp	Independent
Iner	Inertia
Inh	Inhibit
Inl	Inline
Inlet	Inlet
Inn	Inner
Ins	Insulation
Insol	Insolation
Inst	Instantaneous
Int	Integer
Intm	Intermediate
Intn	Internal
Intr	Interrupt, interruption
Intv	Interval
Inv	Inverter, inverted, inverse
Isc	Integer status control
Isld	Islanded
Iso	Isolation
Iu	Information unavailable
Ix	Index
Jmp	Jump
Jnt	Joint
K	Constant (regulation)

Documents
Document Sharing Hub
Full document details: PD IEC TR 61850-90-9:2020

Term	Description
K0Fact	Zero-sequence (residual) compensation factor
KFact	K factor (harmonics)
Kck	Kicker
Key	Key, physical control device
L	Lower (action)
LDC	Line drop compensation
LDCR	Line drop compensation resistance
LDCX	Line drop compensation reactance
LDCZ	Line drop compensation impedance
LED	Light-emitting diode
LTC	Load tap changer
Last	Last
Ld	Lead
Ldp	Link discovery protocol
Leap	Leap (second)
Len	Length
Lev	Level
Lft	Lifting, lift
Lg	Lag
Life	Lifetime
Lim	Limit
Lin	Line
Liv	Live
Lkd	Locked
Lkg	Leakage
Ll	Last long (interval)
Lo	Low (state or value)

Term	Description
Loc	Local
Locb	Log control block
Lod	Load, loading
Log	Log
Lok	(use Lkd instead) Locked
Loop	Loop
Los	Loss
Ls	Last short (interval)
Lst	List
Lub	Lubrication
Lum	Luminosity
M	Minutes
MV	Measured value CDC
Mac	Media access control, MAC-address
Made	Made
Mag	Magnetic, magnitude
Maint	Maintenance
Man	Manual
Mat	Material
Mau	Medium access unit
Max	Maximum
Mbr	Membrane
Md	Motor drive
Mdul	Module
Meas	Measurement
Mech	Mechanical
Media	Media

Documents
Document Sharing Hub
Full document details: PD IEC TR 61850-90-9:2020

Term	Description
Mem	Memory
Min	Minimum
Mir	Mirror
Mlt	Multiple
Mns	Mains
Mod	Mode
Mot	Motor
Mrg	Margin
Mrk	Market
Mst	Moisture
Msv	Main signaling voltage
Msvcb	Multicast sampled values control block
Mth	Method
Mult	Multiplier
Mvm	Movement, moving
N2	Nitrogen
NOx	Nitrogen oxide
NQS	Average partial discharge current
Nam	Name
Name	Name (reserved for use in data objects EEName and LNName only)
Ndl	Needle (used in Pelton turbines)
NdsCom	Needs commissioning
Neut	Neutral
Ng	Negative
Ngt	Nogotiation
Nhd	Net head
Night	Night

Term	Description
No	No, not
Nom	Nominal, normalising
Num	Number
Nxt	Next
O2	Oxygen
O3	Ozon, trioxygen
Obl	Obligation
Oc	Open circuit
Odd	Odd
Of	Offline
Off	Off, device disengaged, not running
Ofs	Offset
Oil	Oil
On	On, device applied, running
Oo	Out of
Op	Operate, operating, operation
Operate	Operate order to any device
Opn	Open, opened
Ord	Order
Out	Output
Ov	Over, override, overflow
Ovl	Overload
Ox	Oxidant
P	Proportional
PF	Power factor
PH	Acidity, value of pH
PNV	Phase-to-neutral voltage

Documents
Document Sharing Hub
Full document details: PD IEC TR 61850-90-9:2020

Term	Description
POW	Point on wave switching
PP	Phase to phase
PPV	Phase to phase voltage
PT1	Low-pass exponential time rate filter
Pa	Partial
Pair	Pair, paired
Pap	Paper
Par	Parallel
Pas	Passive
Path	Path
Pcb	Power quality classifier bin
Pct	Percent, percentage
Pdm	Power quality demodulation
Pe	Electric Power
Per	Periodic, period
Ph	Phase to reference
Phs	Phase
Phy	Physical
Pi	Instantaneous real power
Pin	Pin
Pipe	Pipe
Pk	Peak
Pl	Plant
Plg	Plug
Pls	Pulse
Plt	Plate; long-term flicker severity
Pmp	Pump

Term	Description
Po	Polar
Pol	Polarizing
Polytr	Polytropic
Port	Port
Pos	Position
Pot	Potentiometer
Prc	Price, pricing
Pre	Pre-
Prec	Precondition, initial status
Pres	Pressure
Prg	Progress, in progress
Prim	Primary
Prio	priority
Prm	Permissive
Pro	Protection
Proc	Process
Proxy	Proxy
Prs	Presence
Prt	Parts, part
Ps	Positive
Psk	Penstock
Pss	PSS, power system stabiliser function
Pst	Post, short-term flicker severity
Pt	Point
Pth	Pitch
Pwr	Power
Qty	Quantity

Documents
Document Sharing Hub
Full document details: PD IEC TR 61850-90-9:2020

Term	Description
Qu	Queue
Qud	Quad
R	Raise, increase
Rad	Radiation
Ral	Rail
Ramp	Ramp
Rat	Ratio
Rb	Runner blade
Rcd	Record, recording
Rch	Reach
Rcl	Reclaim
Rct	Reaction
Rdy	Ready
Re	Retry
React	Reactance, reactive
Rec	Reclose
Rec1	Reclose after single phase fault
Rec13	Reclose after evolving fault
Rec3	Reclose after three phase fault
Recha	Recharge, recharging
Rect	Rectifier
Red	Redundant; (deprecated meaning) reduction
Ref	Reference
Reg	Regulation
Rel	Release
Req	Requested
Res	Residual

Term	Description
Reso	Resonance
Reuse	Reuse
Rev	Revision
Rf	Refreshment
Rin	Reinsertion
Ris	Resistance
Rl	Relation, relative
Rm	Mutual resistance
Rmp	Ramping, ramp
Rms	Root mean square
Rn	Rain
Rnbk	Runback
Rng	Range
Rod	Rod
Root	Root
Rot	Rotation, rotor
Rpt	Repeat, repetition
Rs	Reset, resettable
Rsl	Result
Rst	Restraint, restriction
Rsv	Reserve
Rt	Ride-through
Rte	Rate
Rtg	Rating
Rub	Run-up/back
Run	Run
Rv	Reverse

Documents
Document Sharing Hub
Full document details: PD IEC TR 61850-90-9:2020

Term	Description
Rvc	Rapid voltage change
Rvrt	Revert
Rwy	Runaway, e.g. in runaway speed
Rx	Receive, received
S10	Coefficient S1.0
S12	Coefficient S1.2
SM	Servo, servo-motor
SNL	Speed-no-load, connected but not generating
SOx	Sulphur oxide
SPCSO	Single point controllable status output
SPG	Single point setting CDC
SPS	Single point status CDC
SPI	Single pole/phase
ST	Standard time
Saf	Safety
Sag	Sag
Sar	Surge arrestor
Sat	Saturation
Sc	Short circuit
Scale	Scale
Schd	Schedule
Scnd	Secondary
Sco	Supply change over
Sec	Security
Sel	Select
Self	Self
Seq	Sequence

Term	Description
Ser	Series, serial
Set	Setting
Sgcb	Setting group control block
Sh	Shunt
Shar	Shared
Shft	Shaft
Shld	Shielded
Sig	Signal
Sign	Sign
Sim	Simulation, simulated
Sld	Solidity
Slnt	Salinity, saline content
Slp	Sleep; slip
Smok	Smoke
Smp	Sampling
Snd	Sound pressure
Snpt	Snapshot
Snr	Signal to noise ratio
Snw	Snow
Soc	State of charge
Sof	Switch on to fault
Spc	Single point control
Spcf	Specific
Spd	Speed
Spec	Spectra
Spir	Spiral
Spt	Setpoint

Documents
Document Sharing Hub
Full document details: PD IEC TR 61850-90-9:2020

Term	Description
Sq	Square
Src	Source
Srfc	Surface
St	Status, state
Sta	Station, function at plant level
Stab	Stabilizer
Stat	Statistics
Stc	Stack
Std	Standard
Stdby	Standby
Step	Step
Stk	Stroke
Stl	Still, not moving
Stnd	Stand, standing
Sto	Storage, e.g. activity of storing data
Stop	Stop
Storm	Storm
Stow	Stow
Str	Start
Strg	String
Stt	Stator
Stuck	Stuck, cannot move
Sub	Sub
Sum	Sum
Sup	Supply
Sv	Sampled value
SvCBRef	SV control block reference

Term	Description
Svc	Service
Sw	Switch, switched
Swg	Swing
Swl	Power quality event swell
Syn	Synchronisation, synchronous, synchronism, synchrocheck
Sys	System
TP	Three pole/phase
Ta	Armature time constant
Tag	Tag (maintenance work in progress)
Tap	Tap
Task	Task
Td	Transformer derating
Td0p	Td0'
Td0s	Td0''
Tdd	Total demand distortion
Tdf	Transformer derating factor
Tdp	Td'
Tds	Td''
Tech	Technology
Term	Termination
Test	Test
Tgt	Target
Thd	Total harmonic distortion
Thm	Thermal
Ti	Telephone influence
Tilt	Tilt
Tm	Time

Documents
Document Sharing Hub
Full document details: PD IEC TR 61850-90-9:2020

Term	Description
Tm1	Time constant 1
Tm2	Time constant 2
Tm3	Time constant 3
Tmh	Time in h
Tmm	Time in min
Tmms	Time in ms
Tmp	Temperature (°C)
Tms	Time in s
Tnk	Tank
Tns	Tension (stress)
Top	Top (position)
Topo	Topology
Torq	Torque
Tot	Total
Tow	Tower
Tp	Test Point
Tpc	Teleprotection
Tpy	Temporarily
Tq0p	Tq0'
Tq0s	Tq0''
Tqp	Tq'
Tqs	Tq''
Tr	Trip (electrical protection function)
Trf	Transformer
Trg	Trigger
Trip	Trip (non-electrical function)
Trk	Track, tracking

Term	Description
Trp	Transient Performance Class
Trs	Transient
Trunk	Trunk
Ts	Total signed
Tu	Total unsigned
Tun	Tuning
Tur	Turbine
Tx	Transmit, transmitted
Typ	Type
UPS	Uninterruptible power supply
UTC	Coordinated Universal Time
Uhf	Ultra-high-frequency
Un	Un-; under
Unav	Unavailable
Unb	Unbalanced
Unld	Unload
Unt	Unit, production unit
Up	Up, upstream
Ups	Uninterruptible Power Supply
Urcb	Unbuffered report control block
Use	Use
Used	Used
Usvcb	Unicast sampled values control block
Util	Utility
V	Voltage
V1	Voltage at side 1
V2	Voltage at side 2

Documents
Document Sharing Hub
Full document details: PD IEC TR 61850-90-9:2020

Term	Description
VA	Apparent power (volt amperes)
VAh	Apparent energy
VAr	Reactive power (volt amperes reactive)
VArh	Reactive energy
Va	Variation
Vac	Vacuum
Val	Value
Vbr	Vibration
Ver	Vertical
Viol	Violation
Vis	Visibility
Visc	Viscosity
Vlan	VLAN
Vld	Valid, validate, validated
Vlm	Volume
Vlv	Valve
Vol	Voltage DC or non-phase-related AC
VolAmpr	Non-phase-related AC reactive power
Vss	Steady state voltage
W	Active power
W200	Watts peak at 200 W/m2
Wac	Watchdog
Wash	Washout
Watt	Active power non-phase-related AC
Wav	Wave, waveform
Wd	Wind
Week	Week

Term	Description
Wei	Weak end infeed
Wet	Wet
Wgt	Weight
Wh	Watt hours
Wid	Width
Win	Window
Wkup	Wake up
Wld	Welding
Wnd	Winding
Wrm	Warm
Wrn	Warning, warning trigger status
Wrs	Warning trigger status set
Wtr	Water (physical aspect: river, cooling, etc.)
Wup	Windup
X	Reactance (imaginary part of impedance)
X0	Zero sequence reactance
X1	Positive sequence reactance
X2	Negative sequence reactance X2
Xd	Synchronous reactance Xd
Xdir	X-direction
Xdp	Transient synchronous reactance Xd'
Xds	Subtransient reactance Xd''
Xm	Mutual reactance
Xq	Synchronous reactance Xq
Xqp	Transient synchronous reactance Xq'
Xqs	Subtransient reactance Xq''
Xsec	Cross-section

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Term	Description
Ydir	Y-direction
Yw	Yaw
Z	Impedance
Zer	Zero
Zero	(use 'Zer' instead) Zero
Zm	Mutual impedance
Zn	Zone
Zro	Zero sequence
km	Kilometre
ppm	Parts per million

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4 Overview of EESS

4.1 EESS system description

An electrical energy storage system (EESS) is a system which is used for the purpose of intermediate storage of electrical energy. The type of storage, the amount of energy, charging and discharging rates as well as self-discharge rate and many other characteristics are technology dependent and therefore can be very different. However, the general meaning of the characteristics and parameters are identical.

The objective of this document is to define a standardized and general approach to information modelling for operating an EESS regardless of any specific technique, which supports an efficient way of integrating an EESS into grid operation and other businesses.

Various types of EESS, such as battery, pumped hydro, superconducting magnetic energy storage, flywheels, etc., are defined in the "IEC White Paper on Electrical Energy Storage". According to the white paper, EESS systems are classified by energy form, advantages/disadvantages to the specific usages or the purpose of the implementation.

Figure 1 illustrates types of classification for storage systems according to their form of energy storage.

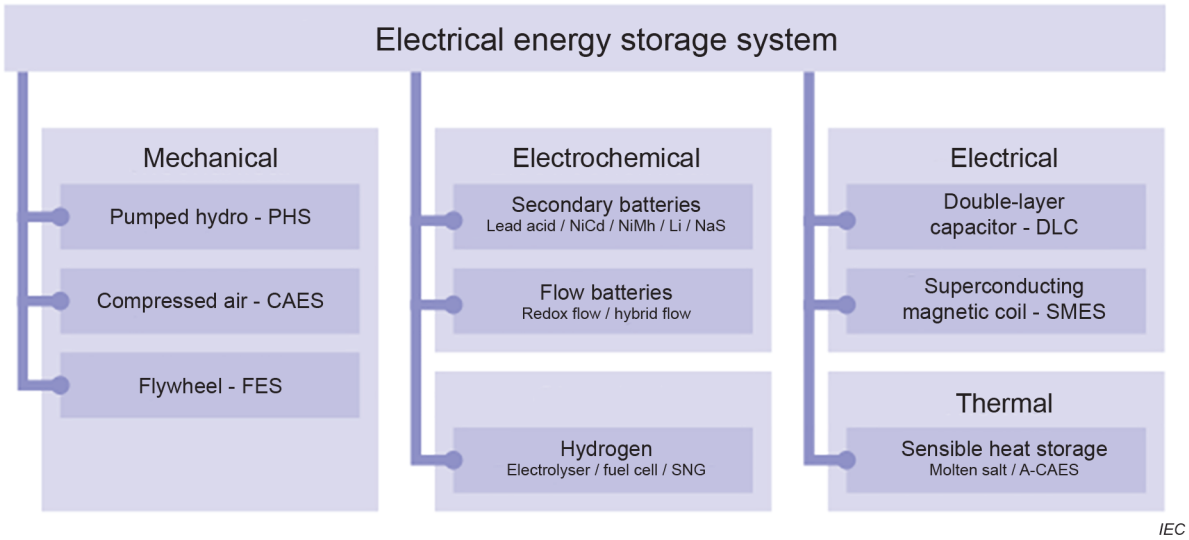

Figure 1 – Classification of electrical energy storage systems according to energy form. IEC-WP [IEC White Paper Electrical Energy Storage:2011])

As illustrated in Figure 2, typical purposes for operating EESS from a utility (T&D) point of view include providing electricity supply reserves, time shifting, primary regulation and power quality management. Due to the fluctuating power supply of PV and wind, EESS can also be used to smooth the total output of the PV/wind facility.

The practical application of EESS systems is constrained by the capability, characteristics, and various conditions of the installation.

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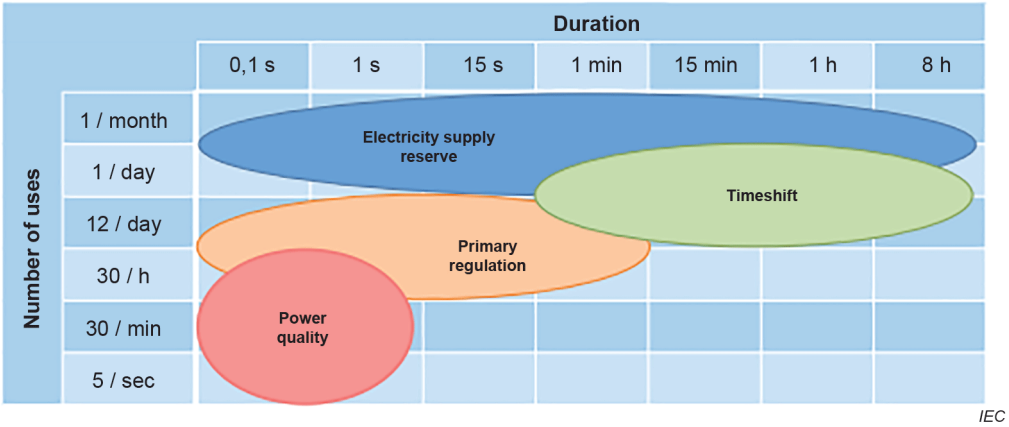

NOTE From IEC White Paper [IEC White Paper Electrical Energy Storage:2011]

Figure 2 – Different uses of electrical energy storage in grids, depending on the frequency and duration of use

4.2 Functional requirements of EESS

The main functionality of EESS connected to the grid for operational purposes is storing electrical energy for use in a different timeframe. In particular, EESS is capable of both providing and/or absorbing electricity to and/or from the grid, according to the operational request from the grid operator or the aggregator or service provider. In the past, the electrical energy storage system was conventionally expected to be used mainly for backup purposes, to supply power during emergency situations to replace the regular source of power.

EESS acts as both generator and load. Charging operations of EESS are similar to controllable load absorbing electrical power from the grid, while discharging operations of EESS are similar to a generator providing power to the grid. Therefore, for generator and load operations, the information models can use the appropriate generation and load DXXX LNs in the second edition of IEC 61850-7-420. However, any storage-specific characteristics are represented by the new storage LN(s) for EESS systems. Such storage-specific characteristics include:

- Data objects which are agnostic with respect to the storage technology such as state of charge, maximum stored energy, charging-discharging round trip efficiency, self-discharge rate, and capacity degradation rate.
- Data objects which are specific to the type of storage concerned. In that case the report only considers battery type storage.

Typically, an EESS includes an electronic based power converter. In case of more detailed modelling of EESS power flow behavior, the converter information model in IEC 61850-7-420 can be used.

4.3 EESS participating in grid operations as a DER system

4.3.1 General

To realize the effective operation and monitoring of EESS from the utility grid point of view, the EESS should be operated according to its rated characteristics and present capabilities through the information exchanged with local (facility or plant) and/or remote power management systems. Utility system operators in DSO/TSO may directly or indirectly manage EESS.

The use case of EESS participating as DER to support grid operations describes an electrical energy storage system that is connected to a distribution network and is part of a virtual power plant (VPP). The VPP control system directly controls the EESS based on the capabilities declared by the EESS and the requirements from the grid.

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4.3.2 Constraints, assumptions, and design considerations

EESS have constraints on their capabilities which must be taken into account when it is supporting grid operations via a local or remote power management system. The information exchanges for identifying these constraints include:

- Nameplate characteristics as well as operational characteristics from the EESS.
- Actual and forecast capabilities and status values from the EESS.
- Setpoints and direct commands to the EESS from the power management system.
- As an option, control through modes or schedules may be implemented for managing the EESS operational functions (information models for these operational functions are defined for all types of DER in IEC 61850-7-420).

In modelling an EESS, the generic view of the system is considered. The focus is on the generic functionalities.

4.4 Hierarchical class model of DER resources

As discussed in IEC 61850-7-420:2009 (first edition), the battery system logical device with ZBAT/ZBTC logical nodes were used to describe the characteristics of batteries. However, ZBAT/ZBTC LNs are intended to be used for batteries that provide auxiliary power, as a source of excitation current, as IED power supply, or as other auxiliary purposes, and are not adequate for EESS used for power utility grid operations. There is a need to fulfil the emerging requirements to make better use of EESS sophisticated capabilities, such as load shifting, frequency control, generation following, etc.

In addition, new DER generator /Controllable load /storage LNs have been developed in the upcoming second edition of IEC 61850-7-420 which represents generic functionalities to support all types of DER. Figure 3 shows a DER hierarchical Class model (inheriting from the IEC 61850-7-4:2010 and IEC 61850-7-4/AMD1:2019 abstract classes) which could be used for different parts of DER management systems, including Storage management system for EESS systems.

Three types of storage elements shall be considered:

- Storage Unit elements (of a specific storage technology type) such as battery
- Composed Storage elements (composed of storage units and possibly including other composed storage elements)
- Generic storage elements, able to reflect the status, characteristic and properties of the “storage part” of a mixed DER, or of a specific storage unit

Since composed generator is de facto agnostic from any technology and thus generic, composed and generic storage elements are covered through the same model, DSTO. The only particularity of composed storage versus generic one is its ability to include references to the storage elements included in the composition. This explains why the presence condition of the DO hosting such references to included storage element (InclSto of ORG type) is Omulti (from 0 to many).

The purpose of this document is therefore to provide modelling details related to electrical energy storage systems and especially battery-based systems.

Goals of this modelling proposal are to:

- Maximize common DOs between the Generic/composed storage and the Storage Unit model (reflecting specific technologies)
- Maximize common DOs between the different types of storage elements

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- Maximize the common DOs to reflect some very specific generator or load properties, status, characteristics of storage element and respectively generator or load equivalent properties.

4.5 DER resource class and composition model for EESS

4.5.1 General

Subclause 4.5 relies on concepts which are developed in the upcoming second edition of IEC 61850-7-420.

4.5.2 DER class model principles for a single storage unit

The simplest DER resource model for EESS consists of a Storage DER unit (e.g. a battery storage system that includes the physical and electrical characteristics of the unit itself) plus charging/discharging/storage information (e.g. nameplate, operational data on what are its operational characteristics). See Figure 3.

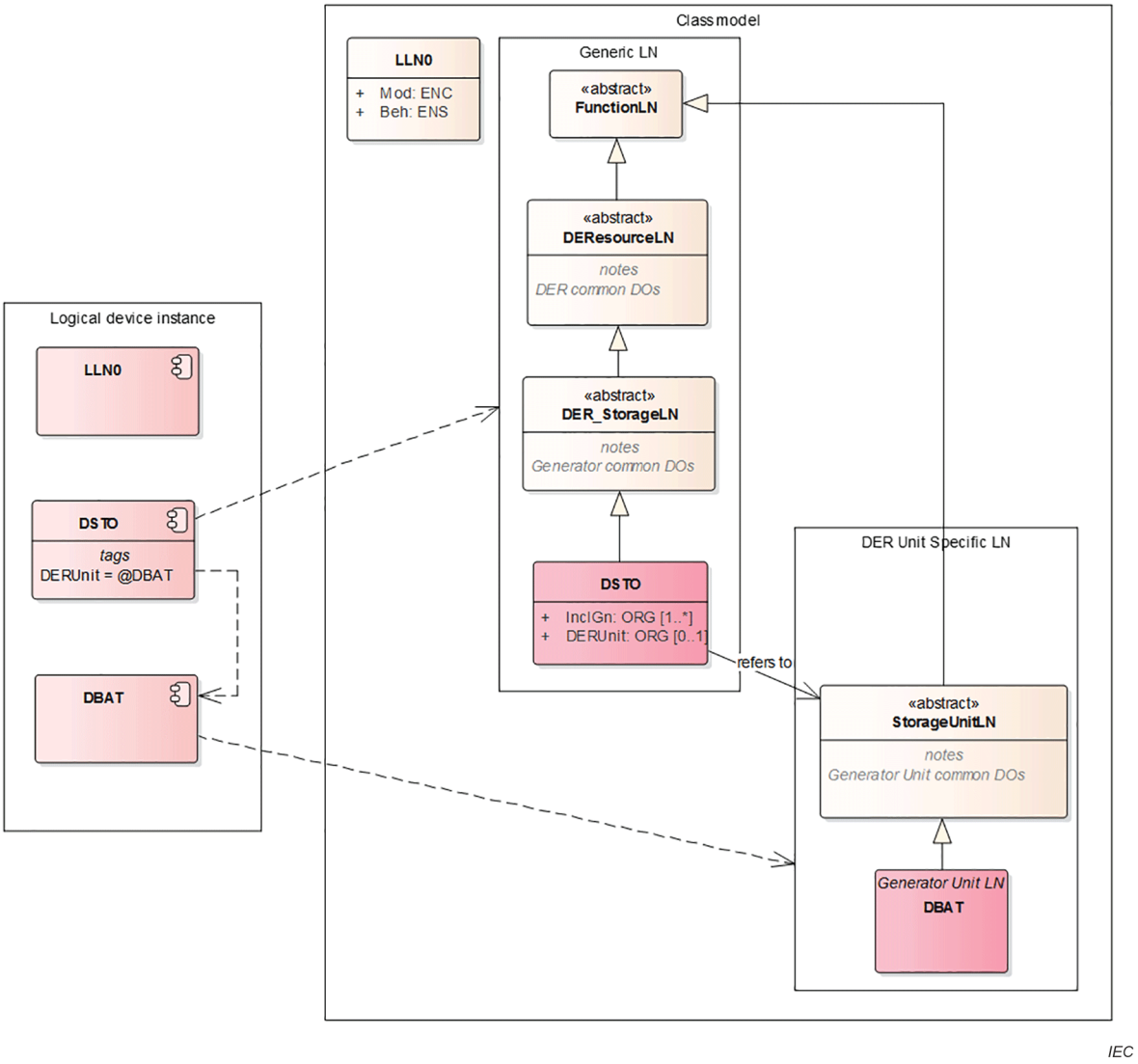

Figure 3 – Simple storage resource model of a battery storage unit (instance & class)

More globally the model includes all possible types of DERs while reusing as much as possible all common elements and sticking to a “single inheritance” schema. Typically, the storage related model expresses that:

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