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Communication networks and systems for power utility automation

Part 7-410: Basic communication structure
— Hydroelectric power plants —
Communication for monitoring and control

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National foreword

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The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by A1 A1.

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Date	Text affected
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**Communication networks and systems for power utility automation -
Part 7-410: Basic communication structure -
Hydroelectric power plants -
Communication for monitoring and control
(IEC 61850-7-410:2012)**

Réseaux et systèmes de communication
pour l'automatisation
des systèmes électriques -
Partie 7-410: Structure
de communication de base -
Centrales hydroélectriques -
Communication pour le contrôle-
commande
(CEI 61850-7-410:2012)

Kommunikationsnetze und -systeme für
die Automatisierung in der elektrischen
Energieversorgung -
Teil 7-410: Wasserkraftwerke -
Kommunikation für Überwachung,
Regelung und Steuerung
(IEC 61850-7-410:2012)

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 57/1274/FDIS, future edition 2 of IEC 61850-7-410, prepared by IEC TC 57 "Power systems management and associated information exchange" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61850-7-410:2013.

The following dates are fixed:

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- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2015-12-04

This document supersedes EN 61850-7-410:2007.

EN 61850-7-410:2013 includes the following significant technical changes with respect to EN 61850-7-410:2007:

- a) The logical nodes in EN 61850-7-410:2007 that were not specific to hydropower plants have been transferred to EN 61850-7-4:2010 and have been removed from this edition of EN 61850-7-410.
- b) The definitions of logical nodes in this edition of EN 61850-7-410 have been updated using the format introduced in EN 61850-7-4:2010.
- c) Most of the modelling examples and background information that was included in EN 61850-7-410:2007 has been transferred to IEC/TR 61850-7-510.
- d) However, this edition of EN 61850-7-410 includes additional general-purpose logical nodes that were not included in EN 61850-7-4:2010, but are required in order to represent the complete control and monitoring system of a hydropower plant.

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Endorsement notice

The text of the International Standard IEC 61850-7-410:2012 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61362	NOTE	Harmonized as EN 61362.
IEC 61850-10	NOTE	Harmonized as EN 61850-10.
IEC 61970-301	NOTE	Harmonized as EN 61970-301.
IEC 62270	NOTE	Harmonized as EN 62270.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC/TS 61850-2	-	Communication networks and systems in substations - Part 2: Glossary	-	-
IEC 61850-7-1	-	Communication networks and systems for power utility automation - Part 7-1: Basic communication structure - Principles and models	EN 61850-7-1	-
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)	EN 61850-7-2	2010
IEC 61850-7-3	2010	Communication networks and systems for power utility automation - Part 7-3: Basic communication structure - Common data classes	EN 61850-7-3	2011
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	EN 61850-7-4	2010

Foreword to amendment A1

The text of document 57/1607/FDIS, future IEC 61850-7-410:2012/A1, prepared by IEC/TC 57 "Power systems management and associated information exchange" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61850-7-410:2013/A1:2016.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2016-09-17
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2018-12-17

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Endorsement notice

The text of the International Standard IEC 61850-7-410:2012/A1:2015 was approved by CENELEC as a European Standard without any modification.

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COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

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

1 Scope

This part of IEC 61850 specifies the additional common data classes, logical nodes and data objects required for the use of IEC 61850 in a hydropower plant.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 in substations – Part 2: Glossary*

IEC 61850-7-1, *Communication networks and systems for power utility automation – Part 7-1: Basic communication structure – Principles and models*

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 61850-7-3:2010, *Communication networks and systems for power utility automation – Part 7-3: Basic communication structure for substations and feeder equipment – Common data classes*

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*

3 Terms and definitions

For the purpose of this document, the terms and definitions given in IEC 61850-2 apply.

4 Abbreviated terms

The terms listed in Table 1 are used to build concatenated Data Object Names in this document. IEC 61850-7-410 inherits all the abbreviated terms described in Clause 4 of IEC 61850-7-4:2010.

NOTE Data Object Names in the logical nodes representing PSS filter functions follow names in IEEE 421.5 as closely as possible. These names are not included in Table 1.

Table 1 – Abbreviated terms

Term	Description	Term	Description
Act	Action, activity, active, activate ^a	Lkg	Leakage
Atr	Actuator	Lo	Low, lower (position) ^a
BG	Before Gain	LoPress	Low pressure
Brg	Bearing	Lub	Lubrication
Boil	Boiler	Man	Manual (- operation selected)
Brk	Brake	Mft	Main fuel trip
Bt	Heartbeat	Mnt	Maintenance
BtB	Back-to-Back	Msk	Mask
Cam	Cam, e.g. rotating non-circular disk	Mtx	Matrix
Cap	Capacity, capability ^a	Ndl	Needle (used in Pelton turbines)
Cbr	Calibration	Nhd	Net head
Cff	Coefficient	Nrm	Normal
Cm	Centimetres	Nxt	Next
Cmpl	Completed, completion, complete	Off	Device disengaged (= off)
Cmpr	Compressor	On	Device applied (= on)
Cnd	Condenser, synchronous compensator	Operate	Operate order to any device
Cndtc	Electrical conductivity [S]	Opn	Open, opened, opening ^a
Crl	Correlation	Pe	Electric power
Crp	Creeping, slow movement	Pmp	Pump
Ctl	Control	Polytr	Polytropic
Cwb	Crowbar	Prec	Precondition, initial status
De	Remove	Prt	Priority
Deg	Degrees, for angle indication in °	Psk	Penstock
Dfl	Deflector (used in Pelton turbines)	Pss	PSS, power system stabiliser function
Dia	Diaphragm	Qu	Queue
Dith	Dither	Rb	Runner blade
Dn	Down, below, downstream, lowest	Reg	Regulation
Drbt	Draft tube	Req	Requested
Droop	Droop	Rh	Re-heat
Dtc	Detection	Rlf	Relief
Dvc	Device	Rng	Range
Dw	Delta Omega	Rpt	Repeat, repetition
Ena	Enable, allow operation ^a	Rtg	Rating, rated
Fa	“Fire all” sequence (to thyristors)	Rwy	Runaway, e.g. in runaway speed
Fbc	Field breaker configuration	Saf	Safety
Fir	Fire	Sft	Soft (as in soft start)
Flm	Flame	Shft	Shaft
Flsh	Flashing (e.g. field flashing)	Sld	Solidity
Flt	Fault	SM	Servo, servo-motor
Flw	Flow, flowing	SNL	Speed-no-load, connected but not generating
Fst	Fast	Spir	Spiral
Gdv	Guide vanes	Src	Source
Grd	Gradient	Srv	Service
Gte	Gate, dam gate	Stl	Still, not moving
Hd	Head	Stm	Steam
HiPres	High pressure	Stnd	Stand, standing
Hwt	Headwater, water level at intake	Syn	Synchronous, synchronism
Hys	Hysteresis	Tp	Test Point
I	Intermediate	Trg	Trigger
Icp	Intercept	Tur	Turbine
Ign	Ignition	Twt	Tailwater, water level at outlet
Iner	Inertia	Unt	Unit, production unit
Inlet	Inlet (to turbine)	Up	Up, above, upstream, upper
Ip	Intermediate pressure	Va	Variable
Jnt	Joint	Vsi	Voltage stabilizer input
Lft	Lifting, lift	Vst	Voltage stabilizer terminal (output)
Lkd	Locked		

^a Extended description of IEC 61850-7-4

5 Logical node classes

5.1 Logical node groups

Logical nodes are grouped together with nodes of similar or related functions having the same first letter. Table 2 shows presently assigned letters, letters marked “reserved” may be used in future extensions to the standard series. Names of logical nodes shall start with the letter of the group to which the LN belongs. E.g. most of the logical nodes, defined in this document, are specific for hydropower use and thus have names that start with the letter H.

Table 2 – List of logical node groups

A	Automatic control functions
B	Reserved
C	Control functions
D	Functions specific to distributed energy resources (DER)
E	Reserved
F	Logical nodes representing functional blocks
G	Generic references
H	Functions specific to hydropower plants
I	Interface and archiving functions
J	Reserved
K	Kinetic energy, mechanical devices and equipment
L	Physical devices and common logical nodes
M	Metering and measurement
N	Reserved
O	Reserved
P	Electrical protections
Q	Power quality
R	Protection related functions
S	Supervision and monitoring
T	Sensors and transmitters (including instrument transformers)
U	Reserved
V	Reserved
W	Functions specific to wind power plants
X	Switchgear
Y	Power transformers
Z	Power system equipment

5.2 Interpretation of logical node tables

The interpretation of the headings for the logical node tables is presented in Table 3.

Table 3 – Interpretation of logical node tables

Data Object Name	Function of the Data Object
Common Data Class	Common Data Class that defines the structure of the Data Object. See IEC 61850-7-3.
Explanation	Short explanation of the data and how it is used.
T	Transient Data – the status of data with this designation is momentary and shall be logged or reported to provide evidence of their momentary state. Some T may be only valid on a modelling level. The TRANSIENT property of DATA only applies to BOOLEAN process data attributes (FC=ST) of that DATA. Transient DATA is identical to normal DATA, except that for the process state change from TRUE to FALSE no event may be generated for reporting and for logging.
M/O	<p>This column defines whether data, data sets, control blocks or services are mandatory (M) or optional (O) for the instantiation of a specific logical node.</p> <p>In some cases a data object can be instantiated; this is marked by “multi”, i.e. Omulti or Mmulti. Instantiation shall be made by numbers 01 to 99, added directly after the data object name. The part of the data object that is instantiated is marked by {inst} in the data object explanation</p> <p>The attributes for data that are instantiated may also be mandatory or optional based on the CDC (Attribute Type) definition in IEC 61850-7-3.</p> <p>Where the letter C is used for “conditional”, at least one of the items of data labelled with C shall be used from each category where C occurs.</p>

All data object names are listed alphabetically in Clause 8. Despite some overlapping, the data in the logical node classes are grouped for the convenience of the reader into some of the following categories.

Common logical node information

Common logical node information is information independent of the dedicated function represented by the LN class. Mandatory data (M) are common to all LN classes; optional data (O) are valid for a reasonable subset of LN classes.

Status information

Status information is data which shows either the status of the process or of the function allocated to the LN class. This information is produced locally and cannot be changed remotely unless substitution is applicable. Data such as “start” or “trip” are listed in this category. Most of these data are mandatory. The data can only be read and not set from an external source.

Settings

Settings are data which are needed for the function to operate. Since many settings are dependent on the implementation of the function, only a commonly agreed minimum is standardised. They may be changed remotely, but normally not very often. The setting can not always be read back; whether it is possible or not depends on the data class used for the setting.

Measured values

Measured values are analogue data measured from the process or calculated in the functions such as currents, voltages, power, etc. This information is produced locally and cannot be changed remotely unless substitution is applicable.

Controls

Controls are data which are changed by commands such as switchgear state (ON/OFF), tap changer position or reset-able counters. They are typically changed remotely, and are changed during operation much more than settings. Data objects under controls cannot be read back.

5.3 Summary of logical node groups to be used in power plants

5.3.1 General

This document specifies the compatible logical node classes to be used in hydropower plants listed in Tables 4 to 12. For other logical node classes that might be of use also in hydropower plants, see IEC 61850-7-4.

5.3.2 Group A – Automatic functions

Table 4 – Logical nodes for automatic functions

LN Class	Description
ACTM	Control mode selection. Overall LN for controllers with different possible modes.
AJCL	Joint control function, to balance total power from different sources.
APSS	PSS Control. Common information of a PSS function.
APST	PSS 2A/B filter. Represents a filter according to IEEE 421.5-2005.
APSF	PSS 4B filter. Represents a filter according to IEEE 421.5-2005.
 ASEQ	Generic control action sequencer

5.3.11 Group E – Thermal power plant specific logical nodes (“Enthalpy”)

Table 16 – Logical nodes representing thermal power

LN Class	Description	
EBCF	Block control function. This LN will represent one physical device that coordinates the control of the thermal pressure of the steam generator and the electrical power regulation of turbine / generator system.	
EFCV	Fuel control valve. This LN will represent the physical device of fuel control valve related to the gas turbine in a thermal power plant.	
EGTU	Gas turbine production unit. This LN represents the physical device of the GT and the generator combination in a thermal power plant. It is intended as an extended rating plate that allows settings of data. It also acts as a placeholder for the current operating conditions of the unit.	
ESCV	Steam control valve. This LN will represent the physical device of inlet control valve of the steam turbine in a thermal power plant.	
ESPD	Speed monitoring. This LN is derived from HSPD.	
ESTU	Steam turbine production unit. This LN represents the physical device of the ST and the generator combination in a thermal power plant. It is intended as an extended rating plate that allows settings of data. It also acts as a placeholder for the current operating conditions of the unit.	
EUNT	Thermal unit operating mode. The present status of the production unit.	

5.3.3 Group F – Functional blocks

Table 5 – Logical nodes representing functional blocks

LN Class	Description	
 FDBF	Dead-band filter. This LN represents a settable filter for dead-band.	
FHBT	Heart-beat. This LN represents the heart-beat function of a controlling device. I.e. the function used to ensure that a specific device or program in a device is running.	
 FMTX	Trip matrix. This LN represents a matrix for linking various trip functions to equipment that shall be tripped or controlled during a fault.	
FSCH	Scheduler. This LN represents a task scheduler that will perform predefined tasks at given times.	
FXPS	Functional priority status. This LN is used to specify in which order devices should be started or activated.	

5.3.12 Group G – Logical nodes for general purposes

Table 17 – Logical nodes representing generic functions references

LN Class	Description	
GUNT	Production unit operating mode. The present status of the production unit.	

5.3.4 Group H – Hydropower specific logical nodes

Table 6 – Hydropower specific logical nodes

LN Class	Description
 ASEQ 	Start / stop sequencer. A simple LN that only presents what the sequencer is doing (inactive – starting – stopping) and in case it is active, what step it is presently working on.
 GUNT 	Hydropower production unit. This LN represents the physical device of the turbine and generator combination in a hydropower plant. It is intended as an extended rating plate that allows temporary settings of data. It also acts as a placeholder for the current operating conditions of the unit.
HBRG	Turbine – generator shaft bearing. This LN holds data pertaining to bearings, such as temperatures and lubrication oil flows.
HCOM	Combinator (3D-CAM or 2D-CAM), optimises the relation between net head, guide vanes and runner blades. It is used in power plants with Kaplan turbines with moveable runner blades. The combinatory function will also use the FCSD LN to hold the relation curves for different net heads.
HDAM	Hydropower dam. A logical node that is used to represent the physical aspects of the dam.
HDFL	Deflector control. This logical node represents the deflector control of a Pelton turbine
HDLS	Dam leakage supervision. Represents a device that will supervise and give alarm in case of dam leakage. The actual measurement can be based on water flow.
HEBR	Electrical brake. This logical node represents an electrical brake system of a turbine.
HGPI	Gate position indicator. A device that provides the position of a dam gate. The position is given either as an angular displacement in case of sector gates or as distance from fully closed position in case of straight gates. For aperture gates and valves where the position is given as percent of full opening, either the HVLV or the SPOS logical nodes are recommended.
HGOV	Governor control. A logical node that represents the overall control of a turbine governor and the various control modes.
HGTE	Dam gate. This LN is intended to hold information about the gate. It can also present a calculated water flow through the gate, in which case the FCSD LN shall be included in the same logical device, to provide the relations. Note that in this LN the position set-point is listed under <i>Controls</i> instead of <i>Settings</i> . The normal way of controlling a gate is to send a position set-point.
HITG	Intake gate. This LN can be used to represent intake gates. The gates will almost never be placed in any other position than fully closed or fully open. However to cater for step-wise or other controls, the gate is normally provided with a number of position switches.
HJCL	Power plant joint control function. In plants with more than one gate or several turbines, this LN will represent the joint control function that is used to supervise the total water flow or to maintain a constant water level. The LN shall be instantiated to provide one instance for each gate and each turbine to be supervised.
HLKG	Leakage supervision. This LN can be used to measure any leakage in the plant, it is more generic than HDLS
HLVL	Water level indicator. The LN represents the water level sensing device. The output is a distance including an offset from a base level (commonly the distance above sea).
HMBR	Mechanical brake for the generator shaft. This is a LN for the brake control. The brake is used for stopping the unit during shut-down and to hold the shaft still, once the unit is stopped.
HNDL	Needle control. A specialised LN that represents the control of needles in Pelton turbines.
HNHD	Net head data. A LN that can be used to present the calculated net head data (difference between upper and lower water levels) in a hydropower plant.
HOTP	Dam overtopping protection. A protection function that will act by opening one or more gates in case of a risk for overtopping the dam. The protection will sometimes include its own water measurement device; hence an optional measured value for water level.
HRES	Water reservoir. A logical node that is used to represent the logical function of a reservoir. If the content is to be calculated, the FCSD LN shall be used to provide the relation between water level and content.

LN Class	Description
HSPD	Speed monitoring. This LN is normally located in a stand-alone logical device, separated from but monitoring the turbine governor. It will also act as a placeholder for various speed limits and set-points used by the start sequencer and other control functions.
HSST	Surge shaft or surge tank. A function that is used to mitigate pressure surges in the system.
HTGV	Guide vanes (wicket gate). This logical node represents the physical device of guide vanes in a hydropower turbine.
HTRB	Runner blades. This logical node represents the physical device of runner blades in e.g. a Kaplan turbine where the runner blades can be controlled.
HTRK	Trash rack, used to prevent floating debris getting into the turbine.
HTUR	Turbine. This logical node holds extended rating plate data for a turbine in a hydropower plant.
HVLV	Valve. This logical node represents a large valve, e.g. a valve in a penstock, butterfly or ball type valve.
HWCL	Water control function. This LN will represent one physical device that can modify the water flow through the plant, either a gate or a turbine. In case of a plant with a joint control function, the HJCL LN will provide the flow set-point to be used by HWCL.

5.3.5 Group I – Interface and archiving

Table 7 – Logical nodes for interface and archiving

LN Class	Description
IFIR	Generic fire detection and alarm function.
IHND	Generic physical human – machine interface. E.g. a push-button or another physical device that can be used as input to a controller.

5.3.6 Group K – Mechanical and non-electrical primary equipment

Table 8 – Logical nodes for mechanical and non-electric primary equipment

LN Class	Description
KHTR	Heater. The LN represents a heater, cubicle heater or any other heater that can be controlled.

5.3.7 Group P – Protection functions

NOTE Most of the logical nodes that represent protective functions are defined in the substation part of the document series.

Table 9 – Logical nodes for protections

LN Class	Description
PRTR	Rotor protection. Field short-circuit protection.
PTUR	Used for detection of under resistance, e.g. due to stator or rotor earth-faults.

5.3.8 Group R – Protection related functions

Table 10 – Logical nodes for protection related functions

LN Class	Description
RFBC	Field breaker configuration.

5.3.9 Group S – Supervision and monitoring

Table 11 – Logical nodes for supervision and monitoring

LN Class	Description
SECW	Supervision of electrical conductivity in water. This logical node represents a system for monitoring of electrical conductivity in water.
SFLW	Media flow supervision. This logical node represents a generic media flow supervision system that can provide alarm and trip signals. In an application, the LN shall be instantiated with one instance per flow being measured.
SLEV	Media level supervision. This logical node represents a generic level supervision system that can provide alarm and trip signals. In an application, the LN shall be instantiated with one instance per surface being measured.
SPOS	Device position supervision. This logical node represents a generic position supervision system that can provide alarm and trip signals. In an application, the LN shall be instantiated with one device being measured.
SPRS	Media pressure supervision. This logical node represents a generic pressure supervision system that can provide alarm and trip signals. In an application, the LN shall be instantiated with one instance per pressure point being measured.

5.3.13 Group T – Transducers and instrument transformers

Table 18 – Logical nodes for transducers

LN Class	Description
TECW	Measurement of electrical conductivity in water. This logical node represents a generic device for measuring the conductivity in water.

5.3.10 Group X – Switchgear

Table 12 – Logical nodes for switchgear

LN Class	Description
XFFL	Field flashing. A logical node to represent the switching control for start excitation (field flashing) of a generator.

5.4 Automatic control logical nodes

LN group A

5.4.1 Modelling remarks

Logical nodes in this group are intended for automatic control functions of general use, i.e. not for any specific area of technology. The logical nodes APSS, APST and APSF below are intended for use in power system stabilizer (PSS) control functions used for large generators.

5.4.2 LN: Control mode selection

Name: ACTM

Logical node ACTM shall be used to present information about different control modes of any control or regulating system. One logical node ACTM must be created for each available control mode.

ACTM class				
Data Object Name	Common Data Class	Explanation	T	M/O
LNName		The name shall be composed of the class name, the LN-Prefix and LN-Instance-ID according to Clause 22 of IEC 61850-7-2:2010.		
Data Objects				
LocKey	SPS	Local or remote key		O
Loc	SPS	Local control behaviour		O
Flt	SPS	Fault in the controller {inst}		Mmulti
LocSta	SPC	Remote control blocked		O
ModAct	SPC	If TRUE this mode is active		M

5.4.3 LN: Joint control

Name: AJCL

The joint control logical node is used to co-ordinate the power production of a power plant with more than one production unit. The joint control function will normally try to optimise the power production between units already in operation. In this control mode, the power plant can be controlled as a single unit. The data attributes shall be instantiated to provide one instance per generating unit to be included in the joint control. Compare also with the HJCL logical node, which can be used to control water flow through a single object of a hydropower plant. Instantiated parts shall be defined in the extended private parts.

AJCL class				
Data Object Name	Common Data Class	Explanation	T	M/O
LNName		The name shall be composed of the class name, the LN-Prefix and LN-Instance-ID according to Clause 22 of IEC 61850-7-2:2010.		
Data Objects				
LocKey	SPS	Local or remote key		O
Loc	SPS	Local control behaviour		O
Unt	SPS	Generation unit {inst} contributing (true = contributing)		Omulti
RSpt	SPS	Raise set-point in IED for unit {inst}	T	Omulti
LSpt	SPS	Lower set-point in IED for unit {inst}	T	Omulti
PwrOut	MV	Contributing power output of the plant (included in the joint control)		O
PwrOutTot	MV	Total power output of the plant		O
LocSta	SPC	Remote control blocked		O
JCtlTag	TAG	Joint Control Maintenance tag affixed to the equipment		O
UntSpt	APC	Set-point for unit {inst}		Omulti
UntStr	SPC	Generation unit {inst} start		Omulti
UntStop	SPC	Generation unit {inst} stop		Omulti
UntTag	TAG	Maintenance tag affixed to the unit {inst}		Omulti
CmdBlk	SPC	Block operation		O
NOTE When both active power set-point (DA:AJCL.UntSpt) in logical node AJCL and active power setpoint (DA:HJCL.ClcPwrSpt) in logical node HJCL are used for power control, only one of the data attributes can be active the other has to be in tracking mode. Use prefixes W for active power and Var for reactive power control. E.g. W_AJCL and Var_AJCL.				

5.4.4 LN: PSS 4B filter function

Name: APSF

This logical node shall be used to represent a PSS 4B filter as given by the IEEE 421.5-2005. It is possible to use the generic filter function FFIL of IEC 61850-7-4 as an alternative,

however the data object names will then not match the names of variables in the IEEE document. See reference [5]¹ for more details on PSS functions.

APSF class				
Data Object Name	Common Data Class	Explanation	T	M/O/C
LNName		The name shall be composed of the class name, the LN-Prefix and LN-Instance-ID according to Clause 22 of IEC 61850-7-2:2010.		
Data Objects				
InputLIHz	APC	Test Input Low- and intermediate frequency		O
InputHHz	APC	Test Input high frequency		O
HiLim	SPS	High limit reached, PSS - filter output		O
LoLim	SPS	Low limit reached, PSS - filter output		O
LHiLim	SPS	High limit reached, LF output		O
LLoLim	SPS	Low limit reached, LF output		O
IHiLim	SPS	High limit reached, IF output		O
ILoLim	SPS	Low limit reached, IF output		O
HHiLim	SPS	High limit reached, HF output		O
HLoLim	SPS	Low limit reached, HF output		O
Out	MV	Output of PSS - filter		O
OutL	MV	Output of Low Frequency part		O
OutI	MV	Output of Intermediate Frequency part		O
OutH	MV	Output of High Frequency part		O
OutLBG	MV	Output of Low Frequency part before gain		O
OutIBG	MV	Output of Intermediate Frequency part before gain		O
OutHBG	MV	Output of High Frequency part before gain		O
ErrTerm	MV	Error term		O
KL	ASG	Proportional gain LF (Low Frequency)		M
KL1	ASG	Proportional gain LF positive		M
KL2	ASG	Proportional gain LF negative		M
KL11	ASG	Lead gain LF positive		M
KL17	ASG	Lead gain LF negative		M
TL1Tms	ING	Time constant TL1 (low frequency positive)		M
TL2Tms	ING	Time constant TL2 (low frequency positive)		M
TL3Tms	ING	Time constant TL3 (low frequency positive)		M
TL4Tms	ING	Time constant TL4 (low frequency positive)		M
TL5Tms	ING	Time constant TL5 (low frequency positive)		M
TL6Tms	ING	Time constant TL6 (low frequency positive)		M
TL7Tms	ING	Time constant TL7 (low frequency negative)		M
TL8Tms	ING	Time constant TL8 (low frequency negative)		M
TL9Tms	ING	Time constant TL9 (low frequency negative)		M
TL10Tms	ING	Time constant TL10 (low frequency negative)		M
TL11Tms	ING	Time constant TL11 (low frequency negative)		M
TL12Tms	ING	Time constant TL12 (low frequency negative)		M
VLMMax	ASG	Maximum limit set-point LF		M
VLMMin	ASG	Minimum limit set-point LF		M
KI	ASG	Proportional gain IF (Intermediate Frequency)		M
KI1	ASG	Proportional gain IF positive		M
KI2	ASG	Proportional gain IF negative		M
KI11	ASG	Lead gain IF positive		M
KI17	ASG	Lead gain IF negative		M
Ti1Tms	ING	Time constant Ti1 (intermediate frequency positive)		M
Ti2Tms	ING	Time constant Ti2 (intermediate frequency positive)		M
Ti3Tms	ING	Time constant Ti3 (intermediate frequency positive)		M
Ti4Tms	ING	Time constant Ti4 (intermediate frequency positive)		M
Ti5Tms	ING	Time constant Ti5 (intermediate frequency positive)		M
Ti6Tms	ING	Time constant Ti6 (intermediate frequency positive)		M
Ti7Tms	ING	Time constant Ti7 (intermediate frequency negative)		M
Ti8Tms	ING	Time constant Ti8 (intermediate frequency negative)		M
Ti9Tms	ING	Time constant Ti9 (intermediate frequency negative)		M
Ti10Tms	ING	Time constant Ti10 (intermediate frequency negative)		M
Ti11Tms	ING	Time constant Ti11 (intermediate frequency negative)		M

¹ Numbers in square brackets refer to the Bibliography.

APSF class				
Data Object Name	Common Data Class	Explanation	T	M/O/C
TI12Tms	ING	Time constant TI12 (intermediate frequency negative)		M
VIMax	ASG	Maximum limit set-point IF		M
VIMin	ASG	Minimum limit set-point IF		M
KH	ASG	Proportional gain HF (High Frequency)		M
KH1	ASG	Proportional gain HF positive		M
KH2	ASG	Proportional gain HF negative		M
KH11	ASG	Lead gain HF positive		M
KH17	ASG	Lead gain HF negative		M
TH1Tms	ING	Time constant TH1 (high frequency positive)		M
TH2Tms	ING	Time constant TH2 (high frequency positive)		M
TH3Tms	ING	Time constant TH3 (high frequency positive)		M
TH4Tms	ING	Time constant TH4 (high frequency positive)		M
TH5Tms	ING	Time constant TH5 (high frequency positive)		M
TH6Tms	ING	Time constant TH6 (high frequency positive)		M
TH7Tms	ING	Time constant TH7 (high frequency negative)		M
TH8Tms	ING	Time constant TH8 (high frequency negative)		M
TH9Tms	ING	Time constant TH9 (high frequency negative)		M
TH10Tms	ING	Time constant TH10 (high frequency negative)		M
TH11Tms	ING	Time constant TH11 (high frequency negative)		M
TH12Tms	ING	Time constant TH12 (high frequency negative)		M
VHMax	ASG	Maximum limit set-point HF		M
VHMin	ASG	Minimum limit set-point HF		M

A comparison between data object names of FFIL and corresponding names in IEEE 421.5-2005 are listed in Table 13.

Table 13 – PSS filter comparison

FFIL	LoPg	LoNg	MePg	MeNg	HiPg	HiNg
Kp	KL1	KL2	KI1	KI2	KH1	KH2
KId	KL11	KL17	KI11	KI17	KH11	KH17
KIg	not used	not used	not used	not used	not used	not used
T1	TL1	TL7	TI1	TI7	TH1	TH7
T1Id	TL2	TL8	TI2	TI8	TH2	TH8
T2	TL3	TL9	TI3	TI9	TH3	TH9
T2Id	TL4	TL10	TI4	TI10	TH4	TH10
T3	TL5	TL11	TI5	TI11	TH5	TH11
T3Id	TL6	TL12	TI6	TI12	TH6	TH12

5.4.5 LN: PSS control, common information

Name: APSS

This logical node shall be used to represent common information and settings of a power system stabilizing (PSS) function.

APSS class				
Data Object Name	Common Data Class	Explanation	T	M/O/C
LNName		The name shall be composed of the class name, the LN-Prefix and LN-Instance-ID according to Clause 22 of IEC 61850-7-2:2010.		
Data Objects				
LocSta	SPC	Remote control blocked		O
OpCntRs	INC	Resetable operation counter		O
BlkPss	SPC	Blocking of the PSS		M
PssAct	SPS	PSS is in action		M
LocKey	SPS	Local or remote key		O
Loc	SPS	Local control behaviour		O

VRefErr	MV	Reference voltage error		O
PreSelPss	SPG	Pre-select PSS 4B if true, Pre-select PSS2A/2B if false		O
PwrMinSet	ASG	Minimum power setting		O
VMax	ASG	Maximum stator voltage		O
AmpMin	ASG	Minimum stator current		O
HzDTmms	ING	Frequency variation derivation time constant		O
HzVaMax	ASG	Maximum frequency variation		O
RsDITmms	ING	Time delay for reset		O
VMin	ASG	Minimum stator voltage		O
VIntTmms	ING	Voltage integration time		O

5.4.6 LN: PSS 2A/B filter function

Name: APST

This logical node shall be used to represent a PSS 2A/B filter as given by the IEEE 421.5-2005. It is possible to use the generic filter function FFIL of IEC 61850-7-4 as an alternative; however, the data object names will then not match the names of variables in IEEE document.

APST class				
Data Object Name	Common Data Class	Explanation	T	M/O/C
LNName		The name shall be composed of the class name, the LN-Prefix and LN-Instance-ID according to Clause 22 of IEC 61850-7-2:2010.		
Data Objects				
InDw	APC	Test Input $\Delta\omega$		O
InPe	APC	Test Input Pe		O
VsiMaxLim	SPS	Input High Limit{inst} reached		Omulti
VsiMinLim	SPS	Input Low Limit{inst} reached		Omulti
VstMaxLim	SPS	Output High Limit reached		O
VstMinLim	SPS	Output Low Limit reached		O
ActualPe	MV	Actual electrical Power		M
ActualDw	MV	Actual $\Delta\omega$		M
ActualTp	MV	Actual output Test-point {inst}		Omulti
Out	MV	PSS output		M
T1Tms	ING	Time constant T1, according to IEEE 421.5-2005		M
T2Tms	ING	Time constant T2, according to IEEE 421.5-2005		M
T3Tms	ING	Time constant T3, according to IEEE 421.5-2005		M
T4Tms	ING	Time constant T4, according to IEEE 421.5-2005		M
T10Tms	ING	Time constant T10, according to IEEE 421.5-2005		C
T11Tms	ING	Time constant T11, according to IEEE 421.5-2005		C
Ks1	ASG	Gain Ks1, according to IEEE 421.5-2005		M
T8Tms	ING	Time constant T8, according to IEEE 421.5-2005		M
T9Tms	ING	Time constant T9, according to IEEE 421.5-2005		M
N	ING	Ramptrack overall degree N, according to IEEE 421.5-2005		M
M	ING	Ramptrack lowpass degree M, according to IEEE 421.5-2005		M
Ks3	ASG	Gain Ks3, according to IEEE 421.5-2005		M
T7Tms	ING	Time constant T7, according to IEEE 421.5-2005		M
Ks2	ASG	Gain Ks2, according to IEEE 421.5-2005		M
TwTms	ING	Time constant wash out Tw{inst}, according to IEEE 421.5-2005		Mmulti
VsiMaxLimSpt	ASG	Input High Limit{inst} set-point		Omulti
VsiMinLimSpt	ASG	Input Low Limit{inst} set-point		Omulti
VstMaxLimSpt	ASG	Output High Limit set-point		O
VstMinLimSpt	ASG	Output Low Limit set-point		O
ScaleDw	ASG	Scaling for Test Input $\Delta\omega$		O
ScalePe	ASG	Scaling for Test Input Pe		O

5.13 Logical nodes for thermal power

LN group E

5.13.1 LN: Block coordination function

Name: EBCF

Logical node EBCF shall be used to coordinate the control of the thermal pressure of the steam generator and the electrical power regulation of turbine / generator system. 

A1

EBCF class																
Data Object Name	Common Data Class	Explanation	T	M/O/C												
LNName		The name shall be composed of the class name, the LN-Prefix and LN-Instance-ID according to IEC 61850-7-2:2010, Clause 22														
Data Objects																
Status information																
GasTurUnt	SPS	Gas turbine generation unit {inst} contributing [True = contributing]		Omulti												
StmTurUnt	SPS	Steam turbine generation unit {inst} contributing [True = contributing]		Omulti												
BoilUnt	SPS	Boiler unit {inst} contributing [True = contributing]		Omulti												
BlkOpSt	ENS	Status of the block. <table><tr><th>Operational condition</th><th>Value</th></tr><tr><td>Undefined</td><td>0</td></tr><tr><td>Coordinated</td><td>1</td></tr><tr><td>Boiler Follow</td><td>2</td></tr><tr><td>Steam Follow</td><td>3</td></tr><tr><td>Gas Follow</td><td>4</td></tr></table>	Operational condition	Value	Undefined	0	Coordinated	1	Boiler Follow	2	Steam Follow	3	Gas Follow	4		M
Operational condition	Value															
Undefined	0															
Coordinated	1															
Boiler Follow	2															
Steam Follow	3															
Gas Follow	4															
GasTurErr	MV	Gas turbine generation unit {inst} error.		Omulti												
StmTurErr	MV	Steam turbine generation unit {inst} error.		Omulti												
BoilErr	MV	Boiler unit {inst} error.		Omulti												
JntCtlTag	TAG	Joint control maintenance tag affixed to the equipment		O												
UntTag	TAG	Maintenance tag affixed to the unit {inst}		Omulti												
CmdBlk	SPC	Block operation		O												
GasTurMft	ACT	Gas turbine generation unit {inst} main fuel trip	T	Omulti												
BoilMft	ACT	Boiler unit {inst} main fuel trip	T	Omulti												

5.13.2 LN: Fuel Control Valve

Name: EFCV

Logical Node EFCV shall be used to represent the physical device of fuel control valve related to the gas turbine in a thermal power plant. In case of individually controlled control valves, it is possible to instantiate the logical node for each control valve.

EFCV class				
Data Object Name	Common Data Class	Explanation	T	M/O/C
LNName		The name shall be composed of the class name, the LN-Prefix and LN-Instance-ID according to IEC 61850-7-2:2010, Clause 22		
Data Objects				
Status information				
PosCls	SPS	Control valve closed		M
PosOpn	SPS	Control valve fully open		M
Controls				
OpCntRs	INC	Resettable operation counter		O
PosSpt	APC	Position set-point		O
DithAct	SPC	Activate dither		O
Measured values				
PosPct	MV	High pressure control valve position as percent of full opening [%]		C
PosDegt	MV	High pressure control valve position in degrees [°]		C

Condition: either PosPct or PosDeg shall be used but not both. 