Protection and control device for MV substation – Communication profile according to IEC61850 for the RGDM control unit

This global standard defines the characteristics of the communication profile (according to IEC 61850 series) for the RGDM control unit (according to GSTP011).

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Revision	Data	List of modifications
00	26.03.2019	First draft
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INDEX

FIGURES

TABLES

1 ACRONYMS

a. **AETA** ENEL custom LN Class: **A**utomatic control **ENEL** **T**opological **A**ddress of an IED

b. **CID** Configured IED Description (XML file)

c. **CP** HV/MV Distribution Substation (also “Primary DS”)

d. **CS** MV/LV Distribution Substation (also “Secondary DS”)

e. **DA** Data Attribute

f. **DER** Distributed Energy Resources

g. **DO** Data Object

h. **DS** Distribution Substation

i. **DSU** Distribution Substation Unit

j. **GP** General Protection of a DER plant

k. **GS** Enel Global Standard

l. **HMI** Human-Machine Interface

m. **HV** High Voltage

n. **ICD** IED Capability Description (XML file)

o. **IDC** Interoperability Device with the Customer

p. **IDC_DER** IDC (functions) related to the DER resources

q. **IDC_Prot** IDC (functions) related to the DER plant Protections

r. **IP** Interface Protection of a DER plant

s. **IED** Intelligent Electronic Device

t. **LN** Logical Node

u. **LD** Logical Device

v. **LV** Low Voltage

w. **MFP** Multifunctional Feeder Protection

x. **MV** Medium Voltage

y. **PoD** Point of Delivery (connection with the DER Plant)

z. **PEOC** ENEL custom LN Class: **PTOC e**xtended with special settings and/or information

aa. **PEOP** ENEL custom LN Class: **PDOP e**xtended with special settings and/or information

bb. **PEOV** ENEL custom LN Class: **PTOV e**xtended with special settings and/or information

cc. REBF ENEL custom LN Class: **RBRF e**xtended with special settings and/or information

dd. REDR ENEL custom LN Class: **RDIR e**xtended with special settings and/or information

ee. RTU Remote Terminal Unit

ff. SCD Substation Configuration Description

gg. SCL Substation Configuration Language

hh. SS Substation

ii. UP2020 Lite Remote Terminal Unit for MV/LV substation according to GSTR002

2 LIST OF COMPONENTS, PRODUCT FAMILY OR SOLUTIONS TO WHICH THE GS APPLIES

The Communication profile for the RGDM control unit described in this GS can be classified in several products provided in Table 1 in GSTP011.

3 NORMATIVE REFERENCES AND BIBLIOGRAPHY

All the references in this GS are intended in the last revision or amendment.

3.1 For all countries

IEEE 802.1Q	IEEE Standards for Local and Metropolitan Networks: Virtual Bridged Local Area Networks - Standard version suitable with the adopted protocols and/or IEC 61850 edition
IEEE C37.2	Electrical Power System Device Function - Numbers and Contact Designation
IEC 61850 series	Communication networks and systems for power utility automation
IEC 62689	Current and voltage sensors or detectors, to be used for fault passage indication purposes
ISO/IEC 8802-3	Information technology -- Telecommunications and information exchange between systems -- Local and metropolitan area networks -- Specific requirements -- Part 3: Standard for Ethernet
RFC 2030	Simple Network Time Protocol (SNTP) V.4; RFC 1305 - Network Time Protocol Version 3 (NTPv3); RFC 5905 - Network Time Protocol Version 4 (NTPv4)

3.2 For EU countries

Countries should kindly declare the applicable local standards.

4 REPLACED STANDARDS

Countries should kindly declare the standards that are replaced by GSTP011.

5 APPLICATION FIELDS

This document standardizes the communication profile for the devices used for protection and control purposes in the ENEL's MV distribution substation – RGDM control unit (by according to GSTP011). This device accomplishes to the definition of IED, by according to IEC 61850 series.

The RGDM control unit, described in GSTP011, is a server that:

a. uses the server-server multicast GOOSE protocol for commands, signalling, remote I/O status updates, diagnostics, etc.;
b. is also capable of supporting a Client/Server unicast, MMS-based messaging with the Client in the DS to ensure commands, configurations and Reports;
c. is able to exchange files via SFTP as well as via the File Transfer service prescribed in the IEC 61850 Standard;

The disturbance recording is not handled via IEC 61850 according to GSTP011.

In this technical specification, when referring to UP2020 Lite RTU, according to GSTR002, also are referred any eventual future developments of MV/LV Substation RTU.

RGDM is compliant with IEC61850 1st Edition. The product is intended to migrate with easiness to IEC61850 2nd Edition when ENEL will decide for this migration to apply.

6 FEATURES OF THE RGDM

6.1 Functional description

The RGDM is an IED that implements a wide set of protection, automation, monitoring and measurement functions according to GSTP011. The IED is typically located in a MV/LV Distribution Substation (also defined Secondary Substation) along the MV feeder. It is connected to MV feeder circuit breaker and/or to MV switch-disconnectors (IMS) and communicates with the other IEDs in the substation and to the remote operation modules.

The IED implements a IEC 61850 Server comprised of six Logical Devices (LDs) each consisting of the Logical Nodes (LNs) that model the data used by the RGDM to accomplish its functions.

6.1.1 Communication inside the DS

The IED will be able to communicate in the LAN in the DS with:

a. the UP2020 Lite (where installed), which works as Client and Distributor of the CID files;

6.1.2 Communication outside the DS

The IED will be able to communicate outside the DS with:

a. the RGDMs installed on the same MV feeder (electrically upstream/downstream) in order to:
   - participate in the Logic Selectivity for the MV Feeder protection by exchanging locking signals (hereafter called BLIND), the Remote Trip and the Remote Close,
   - Remotely Disconnect the Distributed Generation and Loads (by sending the TDLP signal);

b. the MFP at the head of the same MV feeder (for the Logic Selectivity and TDLP);

c. the protections of the downstream distributed generations and/or interruptible loads. The RGDM works as an intermediary for the communication between the MV/LV DS and the DER plant (protections and loads);

d. the DER (generation/storage/load) plant controller. The RGDM works as an intermediary for the communication between the MV/LV DS and the DER plant (generation/storage/load);

e. the Primary Substation RTU in the HV/MV DS with Server tasks (Remote Disconnection);

f. (optionally) with one or more additional clients during the development phase or special/temporary operation sessions.

The RGDM will be able to implement the LNs, protocol stacks and communication services as defined in the IEC 61850 series in order to support the features described in GSTP011 and summarized, for the reader's convenience, in the following section 6.3.

The RGDM will be able to implement functionalities compliant to the requirements defined in IEC 62689; therefore, it is considered as a Distribution Substation Unit (DSU).

6.2 Namespace

ENEL-specific functionalities requires extensions to the IEC 61850 Data Models via ad-hoc Logical Nodes; a dedicated namespace is defined and used accordingly:

a. Namespace id: IEC61850-ENEL-Distribution;

b. Namespace Version: 2018;

c. Namespace release: 2;

d. Namespace release date: 2018-10;

e. Namespace name: "IEC61850-ENEL-Distribution:2018".

6.3 RGDM Functions (Summary)

The functions of the RGDM (refer to GSTP011), which must be supported by the IEC 61850 (data modelling and information exchange), are listed below.

6.3.1 General functions

a. Diagnostic – General state of the RGDM;

b. Configuration management (via CID and direct commands);

c. MV/LV DS Circuit Breaker management (control, configuration, commands, alarms and interlocking);

d. File Transfer (to send/receive the CID files, disturbance recordings, etc.).

6.3.2 Monitoring and Measurement

a. Periodical Instantaneous and Average Measurements of Active Power (P), Reactive Power (Q), Voltages (V) and Currents (I);

b. Monitoring (Periodical Instantaneous and Average Measurements) of the Current and Voltage THD;

c. Event-driven Measurements of Line Voltages (E), Currents (I) (Magnitude and phase angle), Residual Voltage (3Vo), Residual Current (3Io) and Phase difference Angle (between 3Vo and 3Io).

6.3.3 Protection Functions

a. Special settings of the protections:

a.1. operating mode of protection thresholds (Start + Operate, Start only),
a.2. participation in the Logical - Function (FSL),
a.3. 2nd harmonic block,
a.4. selection of definite-time (Ti) and/or inverse-time (Td) operation (Td according to standard curves or to a fixed curve with dedicated parameters; in any case the accelerated stages are definite time,
a.5. Cold Load Pickup function;

b. Phase-Sequence protection related function (47):

b.1. 47.S1 Negative Sequence Overvoltage,
b.2. 47.S1 Positive Sequence Undervoltage,
b.3. Overcurrent protections block conditioning;

c. Negative sequence Overvoltage P59V2;

d. Residual Overvoltage (59N):

d.1. 59N.S1 and 59N.S2;

e. Neutral Overcurrent (51N):

e.1. 51N.S1, 51N.S2 and 51N.S3 with double time calibration for stage acceleration;

f. Phase Overcurrent (OC = 51 if non-directional, 67 if directional) with double time calibration for stage acceleration:

f.1. Common Settings for all Stages,

f.2. OC.S1, OC.S2, OC.S3 and OC.S4 with double time calibration for stage acceleration and enabling/disabling of the directionality;

g. Directional Earth Overcurrent (67N) with double time calibration for stage acceleration:

g.1. Common Settings for all Stages,

g.2. 67N.S1 for compensated neutral network,

g.3. 67N.S2 for isolated neutral network,

g.4. Double earth-fault 67N.S3;

h. Conditioning of:

h.1. Start and/or Operate for OC, 51N and 67N.S3 Stages,

h.2. Start of 67N Stages,

h.3. Operate (per stage) of 67N (Base and Accelerated)

i. Directional Earth Overcurrent for “Arcing Ground” detection 67N.S4;

j. Directional Active Overpower 32P.S1;

k. Discrimination of INRUSH currents, 2nd harmonic (87 2ndH REST);

l. Automatic Load Shedding (EAC) functions:

l.1. Two protection stages, each one including

- Two independent frequency thresholds (Over/Under),
- One Rate of change of frequency threshold,
- Configuration of the operating mode of the frequency-based protection (Ena/Disabling, Over, Under, df/dt, number of measurement, semi-periods);

l.2. Blocking Stages, meant to guarantee the reliability of the frequency-based protections

- Undervoltage (27),
- Overvoltage (59),
- Maximum unbalance β,
- Max frequency difference γ,
- Max variation allowed between consecutive periods Maxdt,
- Reverse Active overpower;

l.3. General Signalling of the RGDM frequency-based protection stages blocking;

m. Broken Conductor (I2/I1) function;

n. Breaker Failure function.

6.3.4 Automation functions

a. Automatic Reclosing function of the MV Circuit Breaker with:

a.1. programmable sequences of different closing types (Fast, Slow and Memorized),

a.2. dedicated management and specific protection stages settings;

b. Logic selectivity of the MV feeder faulty section:

b.1. different logic types (FRT, FSL, DBR, SFS and DSR),

b.2. involved protection stages (OC.S1..S4, 51N.S..S2 and 67N.S1..S3),

b.3. different operations (BLIND, Remote Trip and Remote Close according to the selected logic, Reversal of the Directional Overcurrent Protection tripping sectors);

c. Remote Disconnection (TDLP) of the Distributed Generation and Loads to avoid the unintentional islanding in a faulty MV feeder;

d. Discrimination of the voltage presence/absence on the MV bus-bar and feeder.

6.3.5 Distributed Energy Resources management

a. MV profile regulation by managing the Distributed Generation;

b. Intermediation, for legacy, of the communication (commands, notifications and measurements) between the DER plant (generation/storage/load) and the Client;

c. Control and Remote Disconnection of the IP of the DER plant;

d. Control and Remote Disconnection of the GP of the DER plant;

e. Other actions toward the possible IDCs.

6.3.6 Virtual Inputs and Outputs

a. Handling of experimental I/O (32 inputs and 16 outputs) ready for any future use/development and related communication.

7 LIST OF THE RGDM LOGICAL NODES

This chapter specifies the RGDM data model according to the formal language of the IEC61850 standard.

The Physical Device (IED) consists of six Logical Devices (LDs) relevant to the functions performed by the RGDM in according to GSTP011.

Logical Device: LD General

Logical Nodes \ Functions	IED Nameplate (Vendor, DSP and FW Revision, Serial N., Model and Location)	Diagnostic - General state of the RGDM	MV/LV DS in Local State	CID Management	Instant local Measurements: line currents, phase-to-phase voltages and powers (P, Q)	Instant local Measurements: THD (Line V and I)	Average local Measurements: line currents, phase-to-phase voltages and powers (P, Q)	Average local Measurements: THD (Line V and I)	Event-driven local measurements: Line Currents and Voltages, 3Io and 3Vo (magnitude)	Event-driven local measurements: Io-Vo Phase difference angle	MV Circuit Breaker Open/Close commands	MV Circuit Breaker position (52)	MV Circuit Breaker operations Interlocking	States of the Physical I/O Connector pins of the RGDM
PTOV														
PTUV														
PEOC														
REDR														
PEOP														
PTRC														
PHAR														
PEOV														
REBV														
PEFD														
REBF														
RREC														
CALH		X												
CSWI											X			
XCBR												X		
CILO													X	
MMXU					X		X		X					
MHAI						X		X						
GAPC														
AETA														
GGIO			X	X						X				X
LPHD	X													

Logical Device: LD Protections (1/2)

Logical Nodes \ Functions	(47.S1) Negative Sequence Overvoltage protection	(47.S1) Positive Sequence Undervoltage stage	Summarizer of the RGDM Overcurrent protection Block	(59V2.S1) Negative sequence Overvoltage protection	(59N.S1) Residual Overvoltage protection	(59N.S2) Residual Overvoltage protection	(51N.S1) Neutral Overcurrent Protection (Ti+Td, dual time calibration and other special settings)	(51N.S2) Neutral Overcurrent Protection (Ti+Td, dual time calibration and other special settings)	(51N.S3) Neutral Overcurrent Protection (Ti+Td, dual time calibration and other special settings)	OC Protection General Settings	(OC.S1) Non-Dir./Directional Phase Overcurrent Protect. (Ti+Td, dual time calibration and other special settings)	(OC.S2) Non-Dir./Directional Phase Overcurrent Protect. (Ti+Td, dual time calibration and other special settings)	(OC.S3) Non-Dir./Directional Phase Overcurrent Protect. (Ti+Td, dual time calibration and other special settings)	(OC.S4) Non-Dir./Directional Phase Overcurrent Protect. (Ti+Td, dual time calibration and other special settings)	P67N General Settings	(67N.S1) Dir. Hearth Overcurrent prot. - Compens. Neutr. (Ti+Td, dual time calibr. + other special set.)	(67N.S2) Dir. Hearth Overcurrent prot. - Isol. Neutr. (Ti+Td, dual time calibration and other special settings)	(67N.S3) Dir. Hearth Overcurrent prot. - Double earth-fault prot. (Ti+Td, dual time calibr. + other special set.)
PTOV	X			X														
PTUV		X																
PEOC							X	X	X		X	X	X	X		X	X	X
REDR											X	X	X	X		X	X	X
PEOP																		
PTRC			x															
PHAR																		
PEOV					X	X												
REBV																		
PEFD																		
REBF																		
RREC																		
CALH																		
CSWI																		
XCBR																		
CILO																		
MMXU																		
MHAI																		
GAPC										X					X			
AETA																		
GGIO																		
LPHD																		

Logical Device: LD Protections (2/2)

Logical Nodes \ Functions	(67N.S4) Directional overcurrent "Arcing Ground"protection (with special settings)	Conditioning of the Str and/or Op for specific 51N, OC and 67N stages	(32P.S1) Directional active overpower 32P.S1	Discrimination of INRUSH currents, 2nd harmonic (87 2ndH REST)	EAC - MV automatic load shedding function (general settings)	EAC - Under/Over-voltage blocking stages	EAC - Maximum voltage unbalance blocking stage	EAC - Maximum frequency difference blocking stage	EAC - Maxdt (Maximum allowed variation between consecutive periods) blocking stage	EAC - Reverse Active Overpower blocking stage	EAC - Summarizer of the Block to the frequency-based protection instances of the RGDM	EAC - Frequency and Rate of change of frequency based protection - B1	EAC - Frequency and Rate of change of frequency based protection - B2	BC Broken Conductor	BF50 Breaker Failure (with special settings)	RGDM protections trip conditioning
PTOV																
PTUV																
PEOC																
REDR																
PEOP			X													
PTRC											X					X
PHAR				X												
PEOV																
REBV						X										
PEFD												X	X			
REBF															X	
RREC																
CALH																
CSWI																
XCBR																
CILO																
MMXU																
MHAI																
GAPC	X	X			X		X	X	X	X				X		
AETA																
GGIO																
LPHD																

Logical Device: LD Recloser / LD MV Feeder Automation

Logical Nodes \ Functions	Auto-Reclosing function management (notifications and settings)	Management of the automatic Reclosing (types, timers and notifications)	Failed Reclosing alarm (FR)	Abs./Pres. of the V on the feeder and on the busbar (RVL and RVS signals)	Management of the faulty MV line trunk automatic selection	RGDM Topological Address (TAG)	FSL management (BLIND, Paylod type, timers,...)	FSL - BLIND monitoring (multiple instances)	Remote Trip and Close Management (SFS and DSR)	Remote Disconnection function (TDLP) management	TDLP monitoring (multiple instances)
PTOV											
PTUV											
PEOC											
REDR											
PEOP											
PTRC											
PHAR											
PEOV											
REBV											
PEFD											
REBF											
RREC	X										
CALH			X								
CSWI											
XCBR											
CILO											
MMXU											
MHAI											
GAPC											
AETA						X					
GGIO		X		X	X		X	X	X	X	X
LPHD											

Logical Device: LD Distributed energy Resources Mng. / LD Virutal I/O

Logical Nodes \ Functions	UPG management and notifications to the Client	Commands and/or settings to IDC_DER (fdp, Rcosfi, RQ, RP, RQV, RPRF)	Commands and settings to IDC_DER (fdp, Rcosfi, RQ, RP, RQV, RPRF) from the Client	Remote disconnection commands to IP and GP (IDC_Prot)	Notifications from IP and GP (Circuit Breakers position, P81 thresholds, ..) (IDC_Prot)	Customer's Load Reduction Remote Command and SO command to IDC_Prot	SI, SO and Customer's Load Reduction notifications from IDC_Prot	Alarms and notifications from IDC_DER	State and origin of the operating modes from IDC_DER	Periodic instantaneous measurements (10 sec) from IDC_DER	Periodic average measurements (10 min) from IDC_DER	Virtual Input (Istanze multiple)	Virtual Output
PTOV													
PTUV													
PEOC													
REDR													
PEOP													
PTRC													
PHAR													
PEOV													
REBV													
PEFD													
REBF													
RREC													
CALH													
CSWI													
XCBR													
CILO													
MMXU													
MHAI													
GAPC	X		X										
AETA													
GGIO		X		X	X	X	X	X	X	X	X	X	X
LPHD													

Figure 1 –RGDM Logical Nodes

Figure 1shows the association between a function (column) performed by the RGDM and the dedicated Logical Nodes (rows) that define the data exchanged with the cooperating IEDs and the Client. LLN0 and LPHD are not mentioned as mandatory/default for the LD.

Note: each function could require more than one LN.

It is worth noting that only the functions requiring data and communication according to IEC 61850 are considered in this document.

When deemed necessary for specific project purposes the general classes proposed by the standard have been customized, while still remaining compliant, with the rules and constraints provided by the standard.

The resulting model, in terms of IED, LDs, LNs and their interrelationships is structured as follows:

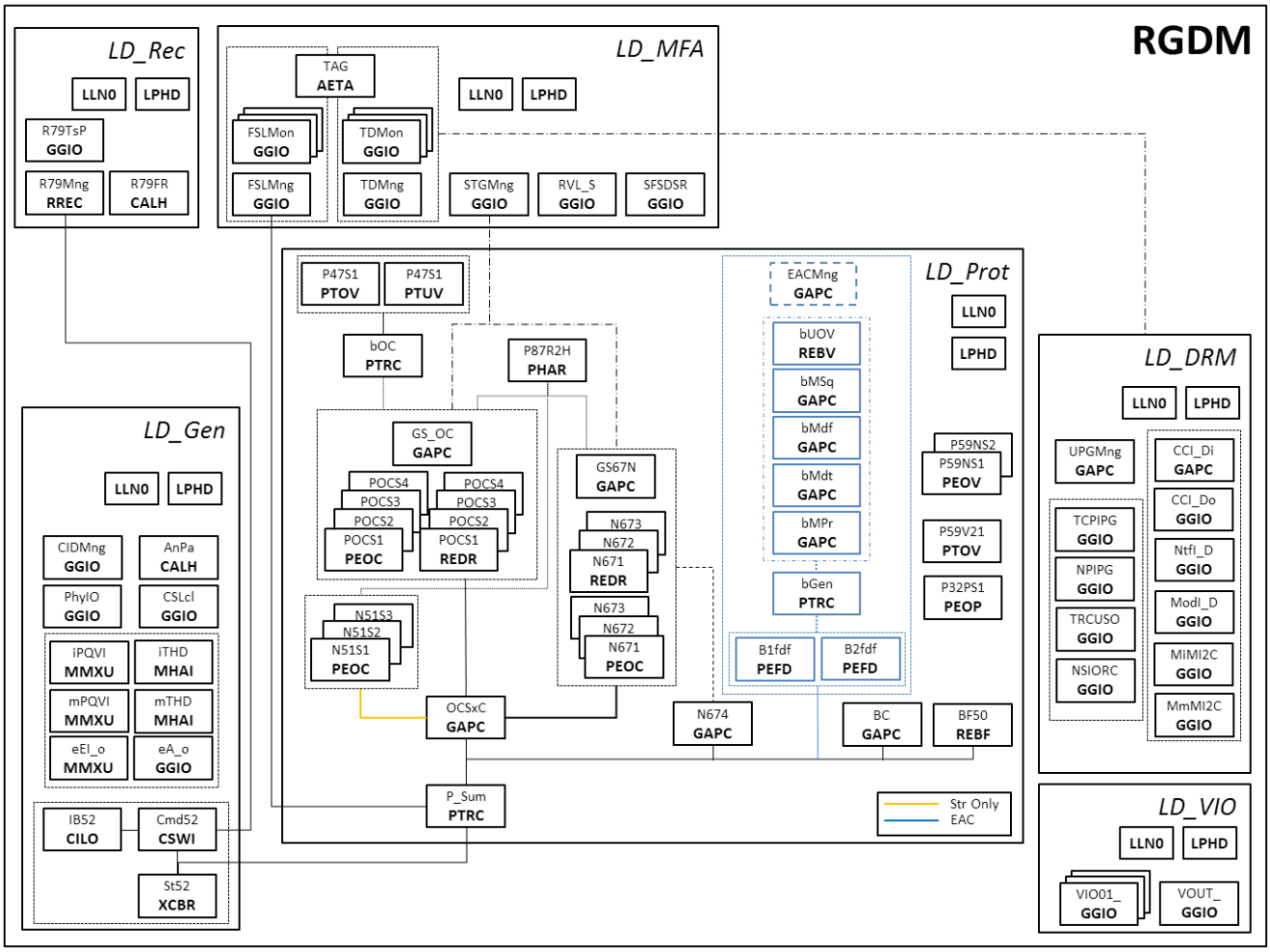

Figure 2 – Organization of the RGDM's IEC61850 model

The following sections prescribe the data (DOs) included in the communication between the RGDM and other IEDs with an exhaustive tabular description for each selected LN.

The typical values of the M/O column

a. M = mandatory,

b. O = optional,

c. C = conditional,

are extended with the additional

d. R = required (that means **mandatory to achieve the requirements of the ENEL project,** regardless of what is stated in the standard).

E.g.: (extracted from LN MMXU)

…	…	…		...
Hz	MV	Frequency		O→**R**
PPV	DEL	Phase to phase voltages (VL1VL2, ...)		O→**R**
PhV	WYE	Phase to ground voltages (VL1ER, ...)		O
A	WYE	Phase currents (IL1, IL2, IL3)		O
W	WYE	Phase active power (P)		O
…	…	…		...

All of the logical nodes defined in are derived from the **Common Logical Node Class**; they will inherit all its mandatory Data; for the optional data there are three possibilities for specialization:

e. the piece of data is not inherited,

f. the piece of data is inherited and left as optional,

g. the piece of data is inherited and defined as mandatory;

Common Logical Node Class				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Mandatory Logical Node Information (Shall be inherited by ALL LN but LPHD)				
Mod	INC	Mode		M
Beh	INS	Behaviour		M
Health	INS	Health		M
NamPlt	LPL	Name plate		M
Optional Logical Node Information				
Loc	SPS	Local operation		O
EEHealth	INS	External equipment health		O
EEName	DPL	External equipment name plate		O
OpCntRs	INC	Operation counter resetable		O
OpCnt	INS	Operation counter		O
OpTmh	INS	Operation time		O
Data Sets (see IEC 61850-7-2)				
Inherited and specialized from Logical Node class (see IEC 61850-7-2)				
Control Blocks (see IEC 61850-7-2)				
Inherited and specialized from Logical Node class (see IEC 61850-7-2)				
Services (see IEC 61850-7-2)				
Inherited and specialized from Logical Node class (see IEC 61850-7-2)				

Each table specifying a LN is followed, where necessary, by notes with details on the modelling;

As an aid to future proofing the IEDs it may be appropriate to seek the agreement of ENEL that additional information (with respect to GSTP011) could be modelled for specific LNs, thus also leveraging the scalability of the IEC-61850 standard;

Most LNs include a counter (resettable or not), which is considered an option by the standard, but is very useful for keeping track of the various states, alarms, parameters etc. depending on the functional requirements of the IED specified in GSTP011 (e.g. number of Start/Operate of a protection, number of issued alarms, number of settings of particular parameters, etc.);

During the prototyping, special ENEL functions will be modelled using standard generic LNs such as CALH, GGIO, GAPC and applying the Extension Rules provided in IEC61850 series. In the final Data Model, as per the agreement with ENEL, these generic IEDs will be replaced with specific LNs with 'Name Space' dedicated to the ENEL project.

The activation/deactivation of a complete functionality will be achieved by controlling the DO Mod that every specific LN inherits as Mandatory from the Common Logical Node Class;

The prefixes used in the model of a LN are, typically, acronyms/abbreviations of the underlying function (e.g. CIDMng is CID Management).

7.1 Logical Device General: details of the Logical Nodes

The Logical Device General (LD_Gen) contains the Logical Nodes required to model the information concerning the overall IED, including the MV Circuit Breaker Control.

LLN0 is used to model the common parts of this Logical Device.

Table 1 – type: LLN01				
Attribute Name	**Attribute Type**	**Explanation**	**T**	**M/O**
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation for complete logical device		O
OpTmh	INS	Operation Time		O
Controls				
Diag	SPC	Run Diagnostic		O
LEDRs	SPC	LED reset	T	O

LPHD models the common parts of the Physical Device that contains this Logical Device. In the LD_Gen it will contain relevant information of the IED: Vendor, DSP and FW Revision, Serial Number, Model and Location.

Table 2 – type: LPHD1 – LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	**T**	**M/O**
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
PhyNam	DPL	Physical device name plate		M
PhyHealth	INS	Physical device health		M
OutOv	SPS	Output communications buffer overflow		O
Proxy	SPS	Indicates if this LN is a proxy		M
InOv	SPS	Input communications buffer overflow		O
NumPwrUp	INS	Number of Power ups		O
WrmStr	INS	Number of Warm Starts		O
WacTrg	INS	Number of watchdog device resets detected		O
PwrUp	SPS	Power Up detected		O
PwrDn	SPS	Power Down detected		O
PwrSupAlm	SPS	External power supply alarm		O
RsStat	SPC	Reset device statistics	T	O

NOTES:

Data → PhyNam: For setting the IED, nameplate details with the appropriate presence constraints of the DA:

a. vendor [M]: the supplier of the device,

b. hwRev [R]: the DSP Rev.,

c. swRev [R]: the FW Rev.,

d. serNum [R]: the serial number of the device,

e. model [R]: RGDM,

f. location [R]: MV/LV Substation (opt. in addition: - the location in the SS, if meaningful for discriminating the functional role of the IED).

7.1.1 Diagnostic – General state of the RGDM

The RGDM implements an internal (HW and SW) diagnostic to monitor and notify, with a specific Alarm "AnPa", its general state.

Table 3 – type:CALH1 – prefix: AnPa – LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Status Information				
GrAlm	SPS	Group alarm		M
GrWrn	SPS	Group warning		O
AllmLstOv	SPS	Alarm list overflow		O

NOTES:

Status Information→ GrAlm: for sending the "AnPa" alarm in case of HW/SW faults of the equipment; it must be consistent with the available HMI (e.g. a LED) and/or log recorder of the IED:

a. 0 = RGDM OK

b. 1 = AnPA.

7.1.2 MV/LV DS in "Local Operation" state

The UP2020 Lite can set the "Local Operation" state of the MV/LV DS, excluding any remote command.

Table 4 – type: GGIO1 – prefix:CSLcl – LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO	SPC	Single point controllable status output		R
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		O

Ind	SPS	General indication (binary input)		O

NOTES:

Common Logical Node Information→ OpCntRs (ready): to count and store the number settings occurred.

Controls → SPCSO: for setting the "Local Operation" state of the MV/LV DS:

a. 0 = MV/LV DS in "Remote Operation" state

b. 1 = MV/LV DS in "Local Operation" state.

7.1.3 CID Management

The CID File, (The naming convention of the CID file is defined in GSTP011) used for the configuration of the IEC61850 communication, is transferred to/from the RGDM via the File Transfer Service (FTP and/or IEC61850); typically, the peer in this procedure is the Client. Upon a successful file transfer, the IED parses the file and loads the configuration into a dedicated memory area (e.g. a stand-by memory bank). When this procedure completes (successfully or not), the RGDM reports the status of the reconfiguration to the peer. In case of positive result, the Client will request the RGDM to switch to the new configuration with a confirmed procedure (File management in the RGDM depends on GSTP011).

Table 5 – type: GGIO2 – prefix:CIDMng - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO	SPC	Single point controllable status output		R
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
IntIn	INS	Integer status input		R
Alm	SPS	General single alarm		O
Ind	SPS	General indication (binary input)		O

NOTES:

Common Logical Node Information→ OpCntRs (ready): to count and store the number of reconfigurations

Controls → SPCSO: to handle the request to change to the new configuration (Boolean = 1). The request is confirmed; at the end of the procedure the RGDM changes the value to 0
Status Information → IntIn: for sending the CIDReconfig notification, according to the outcome of the reconfiguration procedure via a new CID file:

a. 1 = OK;

b. 2 = abnormal/unexpected reconfiguration via new CID;

c. 3 = abnormal/unexpected status after reboot with new reconfiguration.

7.1.4 RGDM Local Measurements

The RGDM, via its own CTs and VTs, carries out the measurements of the main electrical quantities as required by GSTP011; the results are sent with specific reports to the Client. There are three simultaneous measurement campaigns where the sampled quantities are:

a. averaged and reported every 10 seconds (periodic "instantaneous" measurements);

b. averaged and reported every 600 sec (periodic "average" measurements, to be logged, e.g. for MT voltage control);

c. event-driven, a snapshot of the selected electrical quantities sampled and reported when a protection operates (used for the fault analysis). The IED, functionally, must allocate the specified measurement variables so that they are updated via Report only if the RGDM protections are activated. Until the next trigger event, the values do not change to prevent inappropriate traffic to the RTU

In addition, the THDV and THDI are calculated and reported together with the periodic measurements with the same granularity periods. Hereafter the RGDM local measurements are modelled with the relevant LNs. Periodic instantaneous measurements of currents, voltages and powers (P, Q).

Table 6 – type: MMXU1 – prefix: iPQVI - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
Measured values				
TotW	MV	Total Active Power (Total P)		R
TotVAr	MV	Total Reactive Power (Total Q)		R
TotVA	MV	Total Apparent Power (Total S)		O
TotPF	MV	Average Power Factor (Total PF)		O
Hz	MV	Frequency		O
PPV	DEL	Phase to phase voltages (VL1VL2, ...)		R
PhV	WYE	Phase to ground voltages (VL1ER, ...)		O
A	WYE	Phase currents (IL1, IL2, IL3)		R
W	WYE	Phase active power (P)		O
Var	WYE	Phase reactive power (Q)		O
VA	WYE	Phase apparent power (S)		O
PF	WYE	Phase power factor		O
Z	WYE	Phase Impedance		O

NOTES:

Measured values→ TotW: for reporting the measurement (with sign) of the Active Power P (W)

Measured values→ TotVAr: for reporting the measurement (with sign) of the Reactive Power Q (VAr)

Measured values→ PPV: for reporting the measurement of the phase-to-phase Voltages V4-8, V8-12, V12-4 (V)

Measured values→ A: for reporting the measurement of the Line Currents I4, I8, I12 (A).

This In is ready to issue, via goose, the instantaneous measurements of powers (p,q) and voltages to the possible IDC_DERs.

7.1.4.1 Periodic instantaneous measurements of the THD (Feeder V and I)

Table 7 – type: MHAI - prefix: iTHD - LNInstance: 1

Attribute Name	Attribute Type	Explanation	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Measured values				
Hz	MV	Basic Frequency		C
HA	HWYE	Sequence of Harmonics or Interharmonics current		O
HPhV	HWYE	Sequence of Harmonics or Interharominics phase to ground voltages		O
HPPV	HDEL	Sequence of Harmonics or Interharmonics phase to phase voltages		O
HW	HWYE	Sequence of Harmonics or Interharmonics active power		O
HVAr	HWYE	Sequence of Harmonics or Interharmonics reactive power		O
HVA	HWYE	Sequence of Harmonics or Interharmonics apparent power		O
HRmsA	WYE	Current RMS Harmonic or Interharmonics (un-normalized Total harmonic disortion, Thd)		O
HRmsPhV	WYE	Voltage RMS Harmonic or Interharmonics (un-normalized Thd) for phase to ground		O
HRmsPPV	DEL	Voltage RMS Harmonic or Interharmonics (un-normalized Thd) for phase to phase		O
HTuW	WYE	Total phase Harmonic or Interharmonics active power (no fundamental) unsigned sum		O
HTsW	WYE	Total phase Harmonic or Interharmonic active power (no fundamental) signed sum		O
HATm	WYE	Current Time product		O
HKf	WYE	K Factor		O
HTdf	WYE	Transformer derating factor		O
ThdA	WYE	Current Total Harmonic or Interharmonic Distortion (different methods)		R
ThdOddA	WYE	Current Total Harmonic or Interharmonic Distortion (different methods – odd components)		O
ThdEvnA	WYE	Current Total Harmonic or Interharmonic Distortion (different methods – even components)		O
TddA	WYE	Current Total Demand Distortion per IEEE 519		O
TddOddA	WYE	Current Total Demand Distortion per IEEE 519 (odd components)		O
TddEvnA	WYE	Current Total Demand Distortion per IEEE 519 (even components)		O
ThdPhV	WYE	Voltage Total Harmonic or Interharmonic Distortion (different methods) for phase to ground		R
ThdOddPhV	WYE	Voltage Total Harmonic or Interharmonic Distortion (different methods) for phase to ground (odd components)		O
ThdEvnPhV	WYE	Voltage Total Harmonic or Interharmonic Distortion (different methods) for phase to ground (even components)		O
ThdPPV	DEL	Voltage Total Harmonic or Interharmonic Distortion (different methods) for phase to phase		O
ThdOddPPV	DEL	Voltage Total Harmonic or Interharmonic Distortion (different methods) for phase to phase (odd components)		O
ThdEvnPPV	DEL	Voltage Total Harmonic or Interharmonic Distortion (different methods) for phase to phase (even components)		O
HCfPhV	WYE	Voltage crest factors (peak waveform value/sqrt(2)/fundamental) for phase to ground		O
HCfPPV	DEL	Voltage crest factors (peak waveform value/sqrt(2)/fundamental) for phase to phase		O
HCfA	WYE	Current crest factors (peak waveform value/sqrt(2)/fundamental)		O
HTif	WYE	Voltage Telephone Influence Factor		O
Settings				
HzSet	ASG	Basic frequency		C

EvTmms	ASG	Evaluation time (time window) determines the lowest frequency		O
NumCyc	ING	Number of cycles of the basic frequency		O
ThdAVal	ASG	ThdA alarm Setting – value entered in %		O
ThdVVal	ASG	ThdPhV / ThdPPV alarm Setting – value entered in %		O
ThdATmms	ING	ThdA alarm time delay in ms		O
ThdVTmms	ING	ThdPhV / ThdPPV alarm time delay in ms		O
NomA	ASG	Normalising demand current used in IEEE 519 TDD calculation		O

Condition C: Hz and HzSet are exclusive.

NOTES:

Measured values→ ThdA: for reporting the measurement of the MV Feeder Current THD (all the phases)

Measured values→ ThdPhV: for reporting the measurement of the MV Feeder Voltage THD (all the phases).

7.1.4.2 Periodic average measurements of currents, voltages and powers (P, Q)

Table 8 – type:MMXU1 - prefix: mPQVI – LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
Measured values				
TotW	MV	Total Active Power (Total P)		R
TotVAr	MV	Total Reactive Power (Total Q)		R
TotVA	MV	Total Apparent Power (Total S)		O
TotPF	MV	Average Power Factor (Total PF)		O
Hz	MV	Frequency		O
PPV	DEL	Phase to phase voltages (VL1VL2, ...)		R
PhV	WYE	Phase to ground voltages (VL1ER, ...)		O
A	WYE	Phase currents (IL1, IL2, IL3)		R
W	WYE	Phase active power (P)		O
Var	WYE	Phase reactive power (Q)		O
VA	WYE	Phase apparent power (S)		O
PF	WYE	Phase power factor		O
Z	WYE	Phase Impedance		O

NOTES:

Measured values→ TotW: for reporting the measurement (with sign) of the Active Power **P** (W)

Measured values→ TotVAr: for reporting the measurement (with sign) of the Reactive Power **Q** (VAr)

Measured values→ PPV: for reporting the measurement of the phase-to-phase Voltages $V_{4\text{-}8}$, $V_{8\text{-}12}$, $V_{12\text{-}4}$ (V)

Measured values→ A: for reporting the measurement of the Line Currents $\mathbf{I_4}$, $\mathbf{I_8}$, $\mathbf{I_{12}}$ (A).

7.1.4.3 Periodic average measurements of the THD (Line V and I)

Table 9 – type: MHAI1 - prefix: mTHD - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		

Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Measured values				
Hz	MV	Basic Frequency		C
HA	HWYE	Sequence of Harmonics or Interharmonics current		O
HPhV	HWYE	Sequence of Harmonics or Interharominics phase to ground voltages		O
HPPV	HDEL	Sequence of Harmonics or Interharmonics phase to phase voltages		O
HW	HWYE	Sequence of Harmonics or Interharmonics active power		O
HVAr	HWYE	Sequence of Harmonics or Interharmonics reactive power		O
HVA	HWYE	Sequence of Harmonics or Interharmonics apparent power		O
HRmsA	WYE	Current RMS Harmonic or Interharmonics (un-normalized Total harmonic disortion, Thd)		O
HRmsPhV	WYE	Voltage RMS Harmonic or Interharmonics (un-normalized Thd) for phase to ground		O
HRmsPPV	DEL	Voltage RMS Harmonic or Interharmonics (un-normalized Thd) for phase to phase		O
HTuW	WYE	Total phase Harmonic or Interharmonics active power (no fundamental) unsigned sum		O
HTsW	WYE	Total phase Harmonic or Interharmonic active power (no fundamental) signed sum		O
HATm	WYE	Current Time product		O
HKf	WYE	K Factor		O
HTdf	WYE	Transformer derating factor		O
ThdA	WYE	Current Total Harmonic or Interharmonic Distortion (different methods)		R
ThdOddA	WYE	Current Total Harmonic or Interharmonic Distortion (different methods – odd components)		O
ThdEvnA	WYE	Current Total Harmonic or Interharmonic Distortion (different methods – even components)		O
TddA	WYE	Current Total Demand Distortion per IEEE 519		O
TddOddA	WYE	Current Total Demand Distortion per IEEE 519 (odd components)		O
TddEvnA	WYE	Current Total Demand Distortion per IEEE 519 (even components)		O
ThdPhV	WYE	Voltage Total Harmonic or Interharmonic Distortion (different methods) for phase to ground		R
ThdOddPhV	WYE	Voltage Total Harmonic or Interharmonic Distortion (different methods) for phase to ground (odd components)		O
ThdEvnPhV	WYE	Voltage Total Harmonic or Interharmonic Distortion (different methods) for phase to ground (even components)		O
ThdPPV	DEL	Voltage Total Harmonic or Interharmonic Distortion (different methods) for phase to phase		O
ThdOddPPV	DEL	Voltage Total Harmonic or Interharmonic Distortion (different methods) for phase to phase (odd components)		O
ThdEvnPPV	DEL	Voltage Total Harmonic or Interharmonic Distortion (different methods) for phase to phase (even components)		O
HCfPhV	WYE	Voltage crest factors (peak waveform value/sqrt(2)/fundamental) for phase to ground		O
HCfPPV	DEL	Voltage crest factors (peak waveform value/sqrt(2)/fundamental) for phase to phase		O
HCfA	WYE	Current crest factors (peak waveform value/sqrt(2)/fundamental)		O
HTif	WYE	Voltage Telephone Influence Factor		O
Settings				
HzSet	ASG	Basic frequency		C
EvTmms	ASG	Evaluation time (time window) determines the lowest frequency		O
NumCyc	ING	Number of cycles of the basic frequency		O
ThdAVal	ASG	ThdA alarm Setting – value entered in %		O

ThdVVal	ASG	ThdPhV / ThdPPV alarm Setting – value entered in %		O
ThdATmms	ING	ThdA alarm time delay in ms		O
ThdVTmms	ING	ThdPhV / ThdPPV alarm time delay in ms		O
NomA	ASG	Normalising demand current used in IEEE 519 TDD calculation		O

Condition C: Hz and HzSet are exclusive.

NOTES:

Measured values→ ThdA: for reporting the measurement of the MV Line Current THD (all the phases)

Measured values→ ThdPhV: for reporting the measurement of the MV Line Voltage THD (all the phases).

7.1.4.4 Event-driven measurements: Line Voltages and Currents, 3Vo and 3Io

Table 10 – type: MMXU2 - prefix: eEI_o - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
Measured values				
TotW	MV	Total Active Power (Total P)		O
TotVAr	MV	Total Reactive Power (Total Q)		O
TotVA	MV	Total Apparent Power (Total S)		O
TotPF	MV	Average Power Factor (Total PF)		O
Hz	MV	Frequency		O
PPV	DEL	Phase to phase voltages (VL1VL2, ...)		O
PhV	WYE	Phase to ground voltages (VL1ER, ...)		R
A	WYE	Phase currents (IL1, IL2, IL3)		R
W	WYE	Phase active power (P)		O
Var	WYE	Phase reactive power (Q)		O
VA	WYE	Phase apparent power (S)		O
PF	WYE	Phase power factor		O
Z	WYE	Phase Impedance		O

NOTES:

Measured values→ PhV: for reporting the measurement of the Line Voltages $\mathbf{E_4}$, $\mathbf{E_8}$, $\mathbf{E_{12}}$ (magnitude in V and angle) and $\mathbf{3V_o}$ (magnitude in V)

Measured values→ A: for reporting the measurement of the Line Currents $\mathbf{I_4}$, $\mathbf{I_8}$, $\mathbf{I_{12}}$ (magnitude in A and angle) and $\mathbf{3I_o}$ (magnitude in A).

7.1.4.5 Event-driven measurements: $3I_o$-$3V_o$ phase difference angle

Table 11 – type: GGIO3 - prefix: eA_o - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		O

Measured values				
AnIn	MV	Analogue input		R
Controls				
SPCSO	SPC	Single point controllable status output		O
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		O
Ind	SPS	General indication (binary input)		O

NOTES:

Measured values→ AnIn: for reporting the measurement of the $3I_o$-$3V_o$ Phase difference angle.

7.1.5 Management of the MV Circuit Breaker controlled by the RGDM

The following LNs are modelled in the RGDM in order to enable the communication (Controls and Reports) concerning the commands, the position, the possible conflicts of concurrent actions and the anomalies/failures of the MV Circuit Breaker.

7.1.5.1 MV Circuit Breaker Open/Close commands

Table 12 – type: CSWI1 - prefix: Cmd52 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Controls				
Pos	DPC	Switch, general		M
PosA	DPC	Switch L1		O
PosB	DPC	Switch L2		O
PosC	DPC	Switch L3		O
OpOpn	ACT	Operation "Open Switch"	T	R
OpCls	ACT	Operation "Close Switch"	T	R

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of the Circuit Breaker position changes

Controls → Pos: for running the Circuit Breaker Open/Close command

Controls → OpOpn: for reporting the Circuit Breaker Open operation

Controls → OpCls: for reporting the Circuit Breaker Close operation.

7.1.5.2 MV Circuit Breaker position (52)

Table 13 – type:XCBR1 - prefix: St52 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M

Loc	SPS	Local operation (local means without substation automation communication, hardwired direct control)		M
EEHealth	INS	External equipment health		O
EEName	DPL	External equipment name plate		O
OpCnt	INS	Operator counter		M
Controls				
Pos	DPC	Switch position		M
BlkOpn	SPC	Block opening		M
BlkCls	SPC	Block closing		M
ChaMotEna	SPC	Charger motor enabled		O
Metered Values				
SumSwARs	BCR	Sum of Switched Amperes, resettable		O
Status Information				
CBOpCap	INS	Circuit breaker operating capability		M
POWCap	INS	Point On Wave switching capability		O
MaxOpCap	INS	Circuit breaker operating capability when fully charged		O

NOTES:

Common Logical Node Information→ Health: for reporting **AnIn** – the operational condition of the Circuit Breaker:

a. 1 = OK;

b. 2 = Slight Anomaly;

c. 3 = An/In – Circuit Breaker Anomaly

Controls → Pos: for reporting the Circuit Breaker position (intermediate-state | off | on | bad-state).

7.1.5.3 MV Circuit Breaker operations Interlocking

The CILO LN is used to report the result of the Interlocking function (ref. GSTP011) concerning the requests of Circuit Breaker Position Change (e.g. issued by an operator). The Interlocking function is implemented in the RGDM.

Table 14 – type :CILO1 - prefix: IB52 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Status Information				
EnaOpn	SPS	Enable Open		M
EnaCls	SPS	Enable Close		M

NOTES:

Status Information→ EnaOpn: for reporting the Enabling of any Circuit Breaker Open command

Status Information→ EnaCls: for reporting the Enabling of any Circuit Breaker Close command.

7.1.6 States of the Physical I/O Connector pins of the RGDM

The following LN models a set of Boolean variables whose values represent the states of a set of physical I/O's (belonging to a connector) used by specific internal logics of the RGDM. These data are ready for future use/implementation.

Table 15 – type: GGIO7 - prefix: PhyIO - LNInstance: 1

Attribute Name	Attribute Type	Explanation	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO	SPC	Single point controllable status output		O
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		O
Ind1	SPS	General indication (binary input) (1)		R
Ind2	SPS	General indication (binary input) (2)		R
Ind3	SPS	General indication (binary input) (3)		R
Ind4	SPS	General indication (binary input) (4)		R
Ind5	SPS	General indication (binary input) (5)		R
Ind6	SPS	General indication (binary input) (6)		R
Ind7	SPS	General indication (binary input) (7)		R
Ind8	SPS	General indication (binary input) (8)		R
Ind9	SPS	General indication (binary input) (9)		R
Ind10	SPS	General indication (binary input) (10)		R
Ind11	SPS	General indication (binary input) (11)		R

NOTES:

Common Logical Node Information → OpCntRs: to count and store the number of events occurred (e.g. settings)

Status Information → Ind1: RGDM Physical IN 1 State

Status Information → Ind2: RGDM Physical IN 2 State

Status Information → Ind3: RGDM Physical IN 3 State

Status Information → Ind4: RGDM Physical IN 4 State

Status Information → Ind5: RGDM Physical IN 5 State

Status Information → Ind6: RGDM Physical IN 6 State

Status Information → Ind7: RGDM Physical OUT 1 State

Status Information → Ind8: RGDM Physical OUT 2 State

Status Information → Ind9: RGDM Physical OUT 3 State

Status Information → Ind10: RGDM Physical OUT 4 State

Status Information → Ind11: RGDM Physical OUT 5 State.

7.2 Logical Device Protections: details of the Logical Nodes

The Logical Device Protections (LD_Prot) includes all the Logical Nodes which data are used in the communication supporting the Protection functions (and any related ancillary function) implemented in the

RGDM. Some special protections settings that are typical of the ENEL network operation, will be modeled by extending the standard LNs according to the rules set out in the IEC 61850.The information that are logically pertaining to other functions, although protection-related, are not modelled in this LD (e.g. the voltage absence/presence, modelled in the LD_MFA).

Table 16 – LLN02 type				
Attribute Name	**Attribute Type**	**Explanation**	**T**	**M/O**
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation for complete logical device		O
OpTmh	INS	Operation Time		O
Controls				
Diag	SPC	Run Diagnostic		O
LEDRs	SPC	LED reset	T	O

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of all the RGDM protection functions (default: Disabled).

Table 17 – type:LPHD2 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	**T**	**M/O**
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
PhyNam	DPL	Physical device name plate		M
PhyHealth	INS	Physical device health		M
OutOv	SPS	Output communications buffer overflow		O
Proxy	SPS	Indicates if this LN is a proxy		M
InOv	SPS	Input communications buffer overflow		O
NumPwrUp	INS	Number of Power ups		O
WrmStr	INS	Number of Warm Starts		O
WacTrg	INS	Number of watchdog device resets detected		O
PwrUp	SPS	Power Up detected		O
PwrDn	SPS	Power Down detected		O
PwrSupAlm	SPS	External power supply alarm		O
RsStat	SPC	Reset device statistics	T	O

7.2.1 Phase-Sequence protection related function (47)

The operation of this function blocks the operation of the non-directional/directional phase overcurrent and directional earth overcurrent stages. It consists of:

a. one Negative Sequence Overvoltage stage;

b. one Positive Sequence Undervoltage stage;

c. the conditioning of the Overcurrent protections block.

7.2.1.1 Negative Sequence Overvoltage 47.S1 blocking stage

Table 18 – type: PTOV1 - prefix: P47S1– LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		

Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Str	ACD	Start		M
Op	ACT	Operate	T	R
TmVSt	CSD	Active curve characteristic		O
Settings				
TmVCrv	CURVE	Operating Curve Type		O
StrVal	ASG	Start Value		R
TmMult	ASG	Time Dial Multiplier		O
MinOpTmms	ING	Minimum Operate Time		O
MaxOpTmms	ING	Maximum Operate Time		O
OpDlTmms	ING	Operate Delay Time		O
RsDlTmms	ING	Reset Delay Time		O

NOTES:

Common Logical Node Information→ Mod: for handling the Enabling/Disabling command (1/5) of this protection stage (default: Disabled)

Common Logical Node Information → OpCntRs: to count and store the number of operations of this stage

Status Information→ Op: for notifying the blocking of the overcurrent protections due to the Negative Sequence Overvoltage blocking function

Settings→ StrVal: for setting the voltage threshold **Us2>** of 47.S1 (0.7..1; 0.01; 0,8 p.u.).

7.2.1.2 Positive Sequence Undervoltage 47.S1 blocking stage

Table 19 –type: PTUV1 - prefix: P47S1 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Str	ACD	Start		M
Op	ACT	Operate	T	M
TmVSt	CSD	Active curve characteristic		O
Settings				
TmVCrv	CURVE	Operating Curve Type		O
StrVal	ASG	Start Value		R
TmMult	ASG	Time Dial Multiplier		O
MinOpTmms	ING	Minimum Operate Time		O
MaxOpTmms	ING	Maximum Operate Time		O
OpDlTmms	ING	Operate Delay Time		O
RsDlTmms	ING	Reset Delay Time		O

NOTES:

Common Logical Node Information→ Mod: for handling the Enabling/Disabling command (1/5) of this protection stage (default: Disabled)

Common Logical Node Information → OpCntRs: to count and store the number of operations of this stage

Status Information→ Op: for notifying the blocking of the overcurrent protections due to the Positive Sequence Undervoltage blocking function

Settings→ StrVal: for setting the voltage threshold **Us1<** of 47.S1 (0.05..0.3; 0.01; 0.2 p.u.).

The following LN is used to connect the "operate" outputs of the above specified blocking stages to a common "operate" that will block the Overcurrent Protections of the RGDM.

Table 20 – type: PTRC2 - prefix: bOC - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Tr	ACT	Trip		(C) O
Op	ACT	Operate (combination of subscribed Op from protection functions)		(C) R
Str	ACD	Sum of all starts of all connected Logical Nodes		O
Settings				
TrMod	ING	Trip Mode		O
TrPlsTmms	ING	Trip Pulse Time		O

Condition C: At least one of the two status information (Tr, Op) shall be used.

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of blockings to the Overcurrent Protections of the EAC

Status Information→ Op: for notifying the block of the overcurrent protections due to the Phase-Sequence protection related function.

7.2.2 Negative sequence Overvoltage protection (P59V2)

This protection consists of one overvoltage threshold 59V2.S1.

Table 21 – type:PTOV2 - prefix: P59V21 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Str	ACD	Start		M
Op	ACT	Operate	T	R
TmVSt	CSD	Active curve characteristic		O
Settings				
TmVCrv	CURVE	Operating Curve Type		O
StrVal	ASG	Start Value		R
TmMult	ASG	Time Dial Multiplier		O
MinOpTmms	ING	Minimum Operate Time		O
MaxOpTmms	ING	Maximum Operate Time		O

OpDlTmms	ING	Operate Delay Time		R
RsDlTmms	ING	Reset Delay Time		O

NOTES:

Common Logical Node Information→ Mod: for handling the Enabling/Disabling command (1/5) of this protection stage (default: Disabled)

Common Logical Node Information → OpCntRs: to count and store the number of operations of this stage

Status Information→ Op: for notifying the exceeding of the voltage threshold **V** of 59V2.S1

Settings→ StrVal: for setting the voltage threshold **V** of 59V2.S1 (0…50; 0.01; 0.1)

Settings→OpDlTmms: for setting the operate delay time of this stage **T_rit_59V2.S1** (0.05..100 s; 0.01 s; 0.04s) in msec.

7.2.3 Residual Overvoltage protection (59N)

This protection consists of two independent-time overvoltage stages: 59N.S1 and 59N.S2. Only the 59N.S1 is used for reporting to the Client. An ad-hoc LN class is provided, according to the extension rules of the IEC 61850; it permits the selection of the operating modes, special functions and configuration of the parameters.

7.2.3.1 59N.S1 (Ti) stage

Table 22 – type:PEOV1 - prefix: P59NS1 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Str	ACD	Start		M
Op	ACT	Operate	T	R
TmVSt	CSD	Active curve characteristic		O
Settings				
TmVCrv	CURVE	Operating Curve Type		O
StrVal	ASG	Start Value		R
StrValTd	ASG	ENEL Start Value when Td		O
TmMult	ASG	Time Dial Multiplier		O
MinOpTmms	ING	Minimum Operate Time		O
MaxOpTmms	ING	Maximum Operate Time		O
OpDlTmms	ING	Operate Delay Time		R
OpDlTmmsTd	ING	ENEL Operate Delay Time when Td		O
RsDlTmms	ING	Reset Delay Time		R
PBst	SPG	ENEL Protection Behaviour (1=Str 2= Str+Op)		R

NOTES:

Common Logical Node Information→ Mod: for handling the Enabling/Disabling command (1/5) of this protection stage (default: Disabled)

Common Logical Node Information→ OpCntRs: to count and store the number of operations of this stage

Status Information→ Op: for notifying the exceeding of the voltage threshold **V** of **59N.S1**

Settings→ StrVal: for setting the voltage threshold $\mathbf{V_0}$ of **59N.S1** (0..1; 0.01; 0.1)

Settings→ OpDlTmms: for setting the operate delay time of this stage **T59N.S1** (0.05..1000 s; 0.01 s; 1s) in msec

Settings→ RsDlTmms: for setting the drop-off time of **59N.S1** (0..100 s; 0.01 s; 0s) in msec

Settings→ PBst: for setting the behaviour of **59N.S1**:

a. 0 = Start + Operate (default)

b. 1 = Start only.

7.2.3.2 59N.S2 (Ti) stage

Table 23 – PEOV1 type - prefix: P59NS2 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Str	ACD	Start		M
Op	ACT	Operate	T	R
TmVSt	CSD	Active curve characteristic		O
Settings				
TmVCrv	CURVE	Operating Curve Type		O
StrVal	ASG	Start Value		R
StrValTd	ASG	ENEL Start Value when Td		O
TmMult	ASG	Time Dial Multiplier		O
MinOpTmms	ING	Minimum Operate Time		O
MaxOpTmms	ING	Maximum Operate Time		O
OpDlTmms	ING	Operate Delay Time		R
OpDlTmmsTd	ING	ENEL Operate Delay Time when Td		O
RsDlTmms	ING	Reset Delay Time		R
PBst	SPG	ENEL Protection Behaviour (1=Str 2= Str+Op)		R

NOTES:

Common Logical Node Information→ Mod: for handling the Enabling/Disabling command (1/5) of this protection stage (default: Disabled)

Common Logical Node Information→ OpCntRs: to count and store the number of operations of this stage

Status Information→ Op: for notifying the exceeding of the voltage threshold **V** of **59N.S2**

Settings→ StrVal: for setting the voltage threshold $\mathbf{V_0}$ of **59N.S2** (0..1; 0.01; 0.1)

Settings→ OpDlTmms: for setting the operate delay time of this stage **T59N.S2** (0.05..1000 s; 0.01 s; 1s) in msec

Settings→ RsDlTmms: for setting the drop-off time of **59N.S2** (0..100 s; 0.01 s; 0s) in msec

Settings→ PBst: for setting the behaviour of **59N.S2**:

a. 0 = Start + Operate (default)

b. 1 = Start only.

7.2.4 Neutral Overcurrent protection (51N)

This protection consists of three stages with dual time calibration; each stage can be configured as independent-time (Ti) or dependent-time (Td) with selectable standard curves. An ad-hoc LN class is

provided, according to the extension rules of the IEC 61850; it permits the selection of the operating modes, special functions and the configuration of the parameters linked to the curve (Ip, Tp).

7.2.4.1 51N.S1 (Ti+Td) stage with dual time calibration

Table 24 – type:PEOC1 - prefix: N51S1 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/ O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Str	ACD	Start		M
Op	ACT	Operate	T	M
AOp	ACT	ENEL Additional/Accelerated Operate	T	R
TmASt	CSD	Active curve characteristic		O
Settings				
TmACrv	CURVE	Operating Curve Type		R
StrVal	ASG	Start Value		R
TmMult	ASG	Time Dial Multiplier		O
MinOpTmms	ING	Minimum Operate Time		R
MaxOpTmms	ING	Maximum Operate Time		R
OpDlTmms	ING	Operate Delay Time		R
AOpDlTmms	ING	ENEL Additional/Accelerated Operate Delay Time		R
TypRsCrv	ING	Type Reset Curve		O
RsDlTmms	ING	Reset Delay Time		R
DirMod	ING	Directional Mode		O
PAccelEna	SPG	ENEL Protection Acceleration Enabling		R
PBst	SPG	ENEL Protection Behaviour (1=Str 2= Str+Op)		R
FFSEna	SPG	ENEL Fast Fault Selection Enabling (Participation in the Logic Selectivity)		R
Bl2ndHEna	SPG	ENEL Block due to 2nd H Enabling		R
TmACStrVal	ASG	ENEL Active curve characteristic Start Value (Ip for Td curve)		R
TmACOpDlTm	ING	ENEL Active curve characteristic Operate Delay Time (Tp for Td curve)		R
CLPMod	ING	ENEL Cold Load Pickup Mode		R
ACLPOpPer	ASG	ENEL Accelerated and Cold Load Pickup Operating Period		R
CLPCrVlTi	ASG	ENEL Cold Load Pickup Current Value (Ti)		R
CLPCrVlTd	ASG	ENEL Cold Load Pickup Current Value (Td)		R

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of this protection stage (base and accelerated)

Common Logical Node Information→ OpCntRs: to count and store the number of operations of this stage (base and accelerated)

Status Information→ Str: for issuing the Start signal of this stage (base and accelerated)

Status Information→ Op: for issuing the Tripping signal of this stage (base only)

Status Information→ AOp: for sending the Tripping signal of this stage (accelerated only)

Settings→ TmACrv: for setting the **IEC curve type** in case the stage is Td (base only) or if the stage is **Ti**:

a. 9 = NIT (IEC Normal Inverse)

b. 10 = VIT (IEC Very Inverse)

c. 12 = EIT (IEC Extremely Inverse)

d. 14 = LIT (IEC Long – Time Inverse)

e. 15 = Ti (IEC Definite Time)

Settings→ StrVal: for setting the current threshold of this stage (base and accelerated) when Ti (min..max; step; default; m.u.)

Settings→ MinOpTmms: for setting the minimum duration time of the accelerated (only) stage (min..max; step; default; m.u.)

Settings→ MaxOpTmms: for setting the backup time of the stage **Tr51N.S1** when Ti (min..max; step; default; m.u.)

Settings→ OpDlTmms: for setting the operate delay time of the stage **T51N.S1** (base only) when Ti (min..max; step; default; m.u.)

Settings→ AOpDlTmms: for setting the operate delay time of the stage **T51N.S1_c** (accelerated only) when Ti (min..max; step; default; m.u.)

Settings→ RsDlTmms: for setting the drop-Off timer of the stage **51N.S1** (0..100s, 0,01, 0)

Settings→ PAccelEna: for enabling the dual time calibration (acceleration) of this stage:

f. 0 = base only

g. 1 = base + accelerated

Settings→ PBst: for setting the behaviour of this stage (base and accelerated):

h. 0 = Start + Operate

i. 1 = Start only

Settings → FFSEna: for setting the participation in the Logic Selectivity function (publishing and subscribing) of this stage (base and accelerated):

j. 0 = excluded

k. 1 = participating

Settings → Bl2ndHEna: for allowing the blocking, due to 2nd harmonic restraint protection, of this stage (base and accelerated):

l. 0 = not blockable

m. 1 = stage Sx blockable due to 2nd harmonic

Settings → TmACStrVal: for setting the Ip of the curve in case of Td stage (base only) (min..max; step; default; m.u.)

Settings → TmACOpDlTm: for setting the Tp of the curve in case of Td stage (base only) (min..max; step; default; m.u.)

Settings → CLPMod: for setting the mode of the Cold Load Pickup function for this stage:

n. 0 = Off (Default)

o. 1 = On – Stage Block

p. 2 = On – Stage Modification

Settings → ACLPOpPer: for setting the Operating Period of the Acceleration or of the Cold Load Pickup for this stage (0..100;0.01;0.1 sec)

Settings → CLPCrVITi: for setting the Cold Load Pickup Current Value (0,02..3;0,02; 0,6 p.u.) when Ti

Settings → CLPCrVITd: for setting the Cold Load Pickup Current Value (0,02..3;0,02; 0,6 p.u.) when Td.

7.2.4.2 51N.S2 (Ti+Td) stage with dual time calibration

Table 25 – type:PEOC1 - prefix: N51S2 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Str	ACD	Start		M
Op	ACT	Operate	T	M
AOp	ACT	ENEL Additional/Accelerated Operate	T	R
TmASt	CSD	Active curve characteristic		O
Settings				
TmACrv	CURVE	Operating Curve Type		R
StrVal	ASG	Start Value		R
TmMult	ASG	Time Dial Multiplier		O
MinOpTmms	ING	Minimum Operate Time		R
MaxOpTmms	ING	Maximum Operate Time		R
OpDlTmms	ING	Operate Delay Time		R
AOpDlTmms	ING	ENEL Additional/Accelerated Operate Delay Time		R
TypRsCrv	ING	Type Reset Curve		O
RsDlTmms	ING	Reset Delay Time		R
DirMod	ING	Directional Mode		O
PAccelEna	SPG	ENEL Protection Acceleration Enabling		R
PBst	SPG	ENEL Protection Behaviour (1=Str 2= Str+Op)		R
FFSEna	SPG	ENEL Fast Fault Selection Enabling (Participation in the Logic Selectivity)		R
Bl2ndHEna	SPG	ENEL Block due to 2nd H Enabling		R
TmACStrVal	ASG	ENEL Active curve characteristic Start Value (Ip for Td curve)		R
TmACOpDlTm	ING	ENEL Active curve characteristic Operate Delay Time (Tp for Td curve)		R
CLPMod	ING	ENEL Cold Load Pickup Mode		R
ACLPOpPer	ASG	ENEL Accelerated and Cold Load Pickup Operating Period		R
CLPCrVITi	ASG	ENEL Cold Load Pickup Current Value (Ti)		R
CLPCrVITd	ASG	ENEL Cold Load Pickup Current Value (Td)		R

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of this protection stage (base and accelerated)

Common Logical Node Information→ OpCntRs: to count and store the number of operations of this stage (base and accelerated)

Status Information→ Str: for issuing the Start signal of this stage (base and accelerated)

Status Information→ Op: for issuing the Tripping signal of this stage (base only)

Status Information→ AOp: for sending the Tripping signal of this stage (accelerated only)

Settings→ TmACrv: for setting the **IEC curve type** in case the stage is Td (base only) or if the stage is **Ti**:

a. **9 = NIT** (IEC Normal Inverse)

b. **10 = VIT** (IEC Very Inverse)

c. **12 = EIT** (IEC Extremely Inverse)

d. **14 = LIT** (IEC Long – Time Inverse)

e. **15 = Ti** (IEC Definite Time)

Settings→ StrVal: for setting the current threshold of this stage (base and accelerated) when Ti (min..max; step; default; m.u.)

Settings→ MinOpTmms: for setting the minimum duration time of the accelerated (only) stage (min..max; step; default; m.u.)

Settings→ MaxOpTmms: for setting the backup time of the stage **Tr51N.S2** when Ti (min..max; step; default; m.u.)

Settings→ OpDlTmms: for setting the operate delay time of the stage **T51N.S2** (base only) when Ti (min..max; step; default; m.u.)

Settings→ AOpDlTmms: for setting the operate delay time of the stage **T51N.S2_c** (accelerated only) when Ti (min..max; step; default; m.u.)

Settings→ RsDlTmms: for setting the drop-Off timer of the stage **51N.S2** (0..100s, 0,01, 0)

Settings→ PAccelEna: for enabling the dual time calibration (acceleration) of this stage:

f. **0 =** base only

g. **1** = **base + accelerated**

Settings→ PBst: for setting the behaviour of this stage (base and accelerated):

h. 0 = Start + Operate

i. 1 = Start only

Settings → FFSEna: for setting the participation in the Logic Selectivity function (publishing and subscribing) of this stage (base and accelerated):

j. 0 = excluded

k. 1 = participating

Settings → Bl2ndHEna: for allowing the blocking, due to 2nd harmonic restraint protection, of this stage (base and accelerated):

l. 0 = not blockable

m. 1 = stage Sx blockable due to 2nd harmonic

Settings → TmACStrVal: for setting the Ip of the curve in case of Td stage (base only) (min..max; step; default; m.u.)

Settings → TmACOpDlTm: for setting the Tp of the curve in case of Td stage (base only) (min..max; step; default; m.u.)

Settings → CLPMod: for setting the mode of the Cold Load Pickup function for this stage:

n. 0 = Off (Default)

o. 1 = On – Stage Block

p. 2 = On – Stage Modification

Settings → ACLPOpPer: for setting the Operating Period of the Acceleration or of the Cold Load Pickup for this stage (0..100;0.01;0.1 sec)

Settings → CLPCrVlTi: for setting the Cold Load Pickup Current Value (0,02..3;0,02; 0,6 p.u.) when Ti

Settings → CLPCrVlTd: for setting the Cold Load Pickup Current Value (0,02..3;0,02; 0,6 p.u.) when Td.

7.2.4.3 51N.S3 (Ti+Td) stage with dual time calibration

Table 26 – type:PEOC1 - prefix: N51S3 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O

LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Str	ACD	Start		M
Op	ACT	Operate	T	M
AOp	ACT	ENEL Additional/Accelerated Operate	T	R
TmASt	CSD	Active curve characteristic		O
Settings				
TmACrv	CURVE	Operating Curve Type		R
StrVal	ASG	Start Value		R
TmMult	ASG	Time Dial Multiplier		O
MinOpTmms	ING	Minimum Operate Time		R
MaxOpTmms	ING	Maximum Operate Time		R
OpDlTmms	ING	Operate Delay Time		R
AOpDlTmms	ING	ENEL Additional/Accelerated Operate Delay Time		R
TypRsCrv	ING	Type Reset Curve		O
RsDlTmms	ING	Reset Delay Time		R
DirMod	ING	Directional Mode		O
PAccelEna	SPG	ENEL Protection Acceleration Enabling		R
PBst	SPG	ENEL Protection Behaviour (1=Str 2= Str+Op)		R
FFSEna	SPG	ENEL Fast Fault Selection Enabling (Participation in the Logic Selectivity)		R
Bl2ndHEna	SPG	ENEL Block due to 2nd H Enabling		R
TmACStrVal	ASG	ENEL Active curve characteristic Start Value (Ip for Td curve)		R
TmACOpDlTm	ING	ENEL Active curve characteristic Operate Delay Time (Tp for Td curve)		R
CLPMod	ING	ENEL Cold Load Pickup Mode		R
ACLPOpPer	ASG	ENEL Accelerated and Cold Load Pickup Operating Period		R
CLPCrVlTi	ASG	ENEL Cold Load Pickup Current Value (Ti)		R
CLPCrVlTd	ASG	ENEL Cold Load Pickup Current Value (Td)		R

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of this protection stage (base and accelerated)

Common Logical Node Information→ OpCntRs: to count and store the number of operations of this stage (base and accelerated)

Status Information→ Str: for issuing the Start signal of this stage (base and accelerated)

Status Information→ Op: for issuing the Tripping signal of this stage (base only)

Status Information→ AOp: for sending the Tripping signal of this stage (accelerated only)

Settings→ TmACrv: for setting the **IEC curve type** in case the stage is Td (base only) or if the stage is **Ti**:

a. 9 = NIT (IEC Normal Inverse)

b. 10 = VIT (IEC Very Inverse)

c. 12 = EIT (IEC Extremely Inverse)

d. 14 = LIT (IEC Long – Time Inverse)

e. 15 = Ti (IEC Definite Time)

Settings→ StrVal: for setting the current threshold of this stage (base and accelerated) when Ti (min..max; step; default; m.u.)

Settings→ MinOpTmms: for setting the minimum duration time of the accelerated (only) stage (min..max; step; default; m.u.)

Settings→ MaxOpTmms: for setting the backup time of the stage **Tr51N.S3** when Ti (min..max; step; default; m.u.)

Settings→ OpDlTmms: for setting the operate delay time of the stage **T51N.S3** (base only) when Ti (min..max; step; default; m.u.)

Settings→ AOpDlTmms: for setting the operate delay time of the stage **T51N.S3_c** (accelerated only) when Ti (min..max; step; default; m.u.)

Settings→ RsDlTmms: for setting the drop-Off timer of the stage **51N.S3** (0..100s, 0,01, 0)

Settings→ PAccelEna: for enabling the dual time calibration (acceleration) of this stage:

f. 0 = base only

g. 1 = base + accelerated

Settings→ PBst: for setting the behaviour of this stage (base and accelerated):

h. 0 = Start + Operate

i. 1 = Start only

Settings → FFSEna: for setting the participation in the Logic Selectivity function (publishing and subscribing) of this stage (base and accelerated):

j. 0 = excluded

k. 1 = participating

Settings → Bl2ndHEna: for allowing the blocking, due to 2nd harmonic restraint protection, of this stage (base and accelerated):

l. 0 = not blockable

m. 1 = stage Sx blockable due to 2nd harmonic

Settings → TmACStrVal: for setting the Ip of the curve in case of Td stage (base only) (min..max; step; default; m.u.)

Settings → TmACOpDlTm: for setting the Tp of the curve in case of Td stage (base only) (min..max; step; default; m.u.)

Settings → CLPMod: for setting the mode of the Cold Load Pickup function for this stage:

n. 0 = Off (Default)

o. 1 = On – Stage Block

p. 2 = On – Stage Modification

Settings → ACLPOpPer: for setting the Operating Period of the Acceleration or of the Cold Load Pickup for this stage (0..100;0.01;0.1 sec)

Settings → CLPCrVlTi: for setting the Cold Load Pickup Current Value (0,02..3;0,02; 0,6 p.u.) when Ti

Settings → CLPCrVlTd: for setting the Cold Load Pickup Current Value (0,02..3;0,02; 0,6 p.u.) when Td.

7.2.5 Phase Overcurrent protection (Non-directional and Directional)

This protection consists of four stages with dual time calibration; each stage can be configured as independent-time (Ti) or dependent-time (Td) with selectable standard curves as well as non-directional or directional. An ad-hoc LN class is provided, according to the extension rules of the IEC 61850; it permits the selection of the operating modes, special functions (e.g. Cold load Pick-up, participation to the FSL, etc.) and the configuration of the parameters linked to the curve (Ip, Tp).

In addition, a LN is used for the common and general settings of all the overcurrent stages.

For the directional stages, the reversal of the tripping sectors conceptually belongs to the automation logics, in particular after a reconfiguration of the network topology to isolate a faulty section. The reversal is achieved using a single (internal) signal and its description will be done in 7.4.2.

7.2.5.1 OC general settings

Table 27 – type:GAPC4 - prefix: GS_OC - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Controls				
SPCSO1	SPC	Single point controllable status output (1)		R
SPCSO2	SPC	Single point controllable status output (2)		R
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
Auto	SPS	Automatic operation		O
Str	ACD	Start		M
Op	ACT	Operate	T	M
Settings				
StrVal	ASG	Start Value		R

NOTES:

Common Logical Node Information → OpCntRs: to count and store the number of Overcurrent protections general reconfigurations

Controls → SPCSO1: for setting the measuring operating mode of the OC stages:

a. 0 = current (Default)

b. 1 = current*cosfi

Controls → SPCSO2: for setting the operating logic of the OC stages:

c. 0 = 1/3 (Default)

d. 1 = 2/3

Settings → StrVal: for setting the halfwidth of the Tripping Sector of the OC (0..90; 1; 88).

7.2.5.2 OC.S1 (Ti+Td) stage with dual time calibration

Table 28 – type:PEOC2 - prefix: POCS1 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Str	ACD	Start		M

Op	ACT	Operate	T	M
AOp	ACT	ENEL Additional/Accelerated Operate	T	R
TmASt	CSD	Active curve characteristic		O
Settings				
TmACrv	CURVE	Operating Curve Type		R
StrVal	ASG	Start Value		R
TmMult	ASG	Time Dial Multiplier		O
MinOpTmms	ING	Minimum Operate Time		R
MaxOpTmms	ING	Maximum Operate Time		R
OpDlTmms	ING	Operate Delay Time		R
AOpDlTmms	ING	ENEL Additional/Accelerated Operate Delay Time		R
TypRsCrv	ING	Type Reset Curve		O
RsDlTmms	ING	Reset Delay Time		R
DirMod	ING	Directional Mode		R
PAccelEna	SPG	ENEL Protection Acceleration Enabling		R
PBst	SPG	ENEL Protection Behaviour (1=Str 2= Str+Op)		R
FFSEna	SPG	ENEL Fast Fault Selection Enabling (Participation in the Logic Selectivity)		R
Bl2ndHEna	SPG	ENEL Block due to 2nd H Enabling		R
TmACStrVal	ASG	ENEL Active curve characteristic Start Value (Ip for Td curve)		R
TmACOpDlTm	ING	ENEL Active curve characteristic Operate Delay Time (Tp for Td curve)		R
CLPMod	ING	ENEL Cold Load Pickup Mode		R
ACLPOpPer	ASG	ENEL Accelerated and Cold Load Pickup Operating Period		R
CLPCrVlTi	ASG	ENEL Cold Load Pickup Current Value (Ti)		R
CLPCrVlTd	ASG	ENEL Cold Load Pickup Current Value (Td)		R

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of this protection stage (base and accelerated)

Common Logical Node Information→ OpCntRs: to count and store the number of operations of this stage (base and accelerated)

Status Information→ Str: for issuing the Start signal of this stage (base and accelerated)

Status Information→ Op: for issuing the Tripping signal of this stage (base only)

Status Information→ AOp: for sending the Tripping signal of this stage (accelerated only)

Settings→ TmACrv: for setting the **IEC curve type** in case the stage is Td (base only) or if the stage is **Ti**:

a. 9 = NIT (IEC Normal Inverse)

b. 10 = VIT (IEC Very Inverse)

c. 12 = EIT (IEC Extremely Inverse)

d. 14 = LIT (IEC Long – Time Inverse)

e. 15= Ti (IEC Definite Time)

Settings→ StrVal: for setting the current threshold of this stage (base and accelerated) when Ti (min..max; step; default; m.u.)

Settings→ MinOpTmms: for setting the minimum duration time of the accelerated (only) stage (min..max; step; default; m.u.)

Settings→ MaxOpTmms: for setting the backup time of the stage **TrOC.S1** when Ti (min..max; step; default; m.u.)

Settings→ OpDITmms: for setting the operate delay time of the stage **TOC.S1** (base only) when Ti (min..max; step; default; m.u.)

Settings→ AOpDITmms: for setting the operate delay time of the stage **TOC.S1_c** (accelerated only) when Ti (min..max; step; default; m.u.)

Settings→ RsDITmms: for setting the drop-Off timer of the stage **OC.S1** (0..100s, 0,01, 0)

Settings → DirMod: for setting the directionality of this **OC** stage (according to the related REDR settings and the status of the REVERSAL signal form the UP2020 Lite):

f. 1 = 51 non-directional (Default)

g. 2 = 67 Forward

Settings→ PAccelEna: for enabling the dual time calibration (acceleration) of this stage:

h. 0 = base only

i. 1 = base + accelerated

Settings→ PBst: for setting the behaviour of this stage (base and accelerated):

j. **0 =** Start + Operate

k. **1** = **Start only**

Settings → FFSEna: for setting the participation in the Logic Selectivity function (publishing and subscribing) of this stage (base and accelerated):

l. **0 =** excluded

m. **1** = **participating**

Settings → Bl2ndHEna: for allowing the blocking, due to 2nd harmonic restraint protection, of this stage (base and accelerated):

n. **0** = not blockable

o. **1** = **stage Sx blockable due to 2nd harmonic**

Settings → TmACStrVal: for setting the Ip of the curve in case of Td stage (base only) (min..max; step; default; m.u.)

Settings → TmACOpDITm: for setting the Tp of the curve in case of Td stage (base only) (min..max; step; default; m.u.)

Settings → CLPMod: for setting the mode of the Cold Load Pickup function for this stage:

p. 0 = Off (Default)

q. 1 = On – Stage Block

r. 2 = On – Stage Modification

Settings → ACLPOpPer: for setting the Operating Period of the Acceleration or of the Cold Load Pickup for this stage (0..100;0.01;0.1 sec)

Settings → CLPCrVITi: for setting the Cold Load Pickup Current Value (0,02..3;0,02; 0,6 p.u.) when Ti

Settings → CLPCrVITd: for setting the Cold Load Pickup Current Value (0,02..3;0,02; 0,6 p.u.) when Td.

The following REDR LN models the directional data and characteristics of the (base and accelerated) OC.S1 stage only when directional (67).

Table 29 – type:REDR1 - prefix: POCS1 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/ O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				

Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Status Information				
Dir	ACD	Direction		M
Settings				
ChrAng	ASG	Characteristic Angle		R
AChrAng	ASG	ENEL Additional Characteristic Angle		R
MinFwdAng	ASG	Minimum Phase Angle in Forward Direction		R
MinRvAng	ASG	Minimum Phase Angle in Reverse Direction		O
MaxFwdAng	ASG	Maximum Phase Angle in Forward Direction		O
MaxRvAng	ASG	Maximum Phase Angle in Reverse Direction		O
BlkValA	ASG	Minimum operating current	-	O
BlkValV	ASG	Minimum operating voltage	-	O
PolQty	ING	Polarising Quantity		O
MinPPV	ASG	Min Phase-Phase Voltage		O

NOTES:

Settings→ ChrAng: for setting the bisector of the Tripping Sector of the OC.S1 (Ti) stage (0..360; 1, 0)

Settings→ AChrAng: for setting the Additional bisector of the Tripping Sector of the OC.S1 (Td) stage (0..360; 1, 0)

Settings→ MinFwdAng: for setting the halfwidth of the Tripping Sector of the OC.S1 (Ti+Td) stage (0..90,1,88).

7.2.5.3 OC.S2 (Ti+Td) stage with dual time calibration

Table 30 – type:PEOC2 - prefix: POCS2 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Str	ACD	Start		M
Op	ACT	Operate	T	M
AOp	ACT	ENEL Additional/Accelerated Operate	T	R
TmASt	CSD	Active curve characteristic		O
Settings				
TmACrv	CURVE	Operating Curve Type		R
StrVal	ASG	Start Value		R
TmMult	ASG	Time Dial Multiplier		O
MinOpTmms	ING	Minimum Operate Time		R
MaxOpTmms	ING	Maximum Operate Time		R
OpDlTmms	ING	Operate Delay Time		R
AOpDlTmms	ING	ENEL Additional/Accelerated Operate Delay Time		R
TypRsCrv	ING	Type Reset Curve		O
RsDlTmms	ING	Reset Delay Time		R
DirMod	ING	Directional Mode		R
PAccelEna	SPG	ENEL Protection Acceleration Enabling		R
PBst	SPG	ENEL Protection Behaviour (1=Str 2= Str+Op)		R

FFSEna	SPG	ENEL Fast Fault Selection Enabling (Participation in the Logic Selectivity)		R
Bl2ndHEna	SPG	ENEL Block due to 2nd H Enabling		R
TmACStrVal	ASG	ENEL Active curve characteristic Start Value (Ip for Td curve)		R
TmACOpDlTm	ING	ENEL Active curve characteristic Operate Delay Time (Tp for Td curve)		R
CLPMod	ING	ENEL Cold Load Pickup Mode		R
ACLPOpPer	ASG	ENEL Accelerated and Cold Load Pickup Operating Period		R
CLPCrVlTi	ASG	ENEL Cold Load Pickup Current Value (Ti)		R
CLPCrVlTd	ASG	ENEL Cold Load Pickup Current Value (Td)		R

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of this protection stage (base and accelerated)

Common Logical Node Information→ OpCntRs: to count and store the number of operations of this stage (base and accelerated)

Status Information→ Str: for issuing the Start signal of this stage (base and accelerated)

Status Information→ Op: for issuing the Tripping signal of this stage (base only)

Status Information→ AOp: for sending the Tripping signal of this stage (accelerated only)

Settings→ TmACrv: for setting the **IEC curve type** in case the stage is Td (base only) or if the stage is **Ti**:

a. 9 = NIT (IEC Normal Inverse)

b. 10 = VIT (IEC Very Inverse)

c. 12 = EIT (IEC Extremely Inverse)

d. 14 = LIT (IEC Long – Time Inverse)

e. 15 = Ti (IEC Definite Time)

Settings→ StrVal: for setting the current threshold of this stage (base and accelerated) when Ti (min..max; step; default; m.u.)

Settings→ MinOpTmms: for setting the minimum duration time of the accelerated (only) stage (min..max; step; default; m.u.)

Settings→ MaxOpTmms: for setting the backup time of the stage **TrOC.S2** when Ti (min..max; step; default; m.u.)

Settings→ OpDlTmms: for setting the operate delay time of the stage **TOC.S2** (base only) when Ti (min..max; step; default; m.u.)

Settings→ AOpDlTmms: for setting the operate delay time of the stage **TOC.S2_c** (accelerated only) when Ti (min..max; step; default; m.u.)

Settings→ RsDlTmms: for setting the drop-Off timer of the stage **OC.S2** (0..100s, 0,01, 0)

Settings → DirMod: for setting the directionality of this **OC** stage (according to the related REDR settings and the status of the REVERSAL signal form the UP2020 Lite):

f. 1 = 51 non-directional (Default)

g. 2 = 67 Forward

Settings→ PAccelEna: for enabling the dual time calibration (acceleration) of this stage:

h. 0 = base only

i. 1 = base + accelerated

Settings→ PBst: for setting the behaviour of this stage (base and accelerated):

j. 0 = Start + Operate

k. 1 = Start only

Settings → FFSEna: for setting the participation in the Logic Selectivity function (publishing and subscribing) of this stage (base and accelerated):

l. 0 = excluded

m. 1 = participating

Settings → BI2ndHEna: for allowing the blocking, due to 2nd harmonic restraint protection, of this stage (base and accelerated):

n. 0 = not blockable

o. 1 = stage Sx blockable due to 2nd harmonic

Settings → TmACStrVal: for setting the Ip of the curve in case of Td stage (base only) (min..max; step; default; m.u.)

Settings → TmACOpDITm: for setting the Tp of the curve in case of Td stage (base only) (min..max; step; default; m.u.)

Settings → CLPMod: for setting the mode of the Cold Load Pickup function for this stage:

p. 0 = Off (Default)

q. 1 = On – Stage Block

r. 2 = On – Stage Modification

Settings → ACLPOpPer: for setting the Operating Period of the Acceleration or of the Cold Load Pickup for this stage (0..100;0.01;0.1 sec)

Settings → CLPCrVITi: for setting the Cold Load Pickup Current Value (0,02..3;0,02; 0,6 p.u.) when Ti

Settings → CLPCrVITd: for setting the Cold Load Pickup Current Value (0,02..3;0,02; 0,6 p.u.) when Td.

The **following** REDR LN models the directional data and characteristics of the (base and accelerated) OC.S2 stage only when directional (67).

Table 31 – type:EDR1 - prefix: POCS2 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Status Information				
Dir	ACD	Direction		M
Settings				
ChrAng	ASG	Characteristic Angle		R
AChrAng	ASG	ENEL Additional Characteristic Angle		R
MinFwdAng	ASG	Minimum Phase Angle in Forward Direction		R
MinRvAng	ASG	Minimum Phase Angle in Reverse Direction		O
MaxFwdAng	ASG	Maximum Phase Angle in Forward Direction		O
MaxRvAng	ASG	Maximum Phase Angle in Reverse Direction		O
BlkValA	ASG	Minimum operating current	-	O
BlkValV	ASG	Minimum operating voltage	-	O
PolQty	ING	Polarising Quantity		O
MinPPV	ASG	Min Phase-Phase Voltage		O

NOTES:

Settings→ ChrAng: for setting the bisector of the Tripping Sector of the OC.S2 (Ti) stage (0..360; 1, 0)

Settings→ AChrAng: for setting the Additional bisector of the Tripping Sector of the OC.S2 (Td) stage (0..360; 1, 0)

Settings→ MinFwdAng: for setting the halfwidth of the Tripping Sector of the OC.S2 (Ti+Td) stage (0..90,1,88).

7.2.5.4 OC.S3 (Ti+Td) stage with dual time calibration

Table 32 – type:PEOC2 - prefix: POCS3 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Str	ACD	Start		M
Op	ACT	Operate	T	M
AOp	ACT	ENEL Additional/Accelerated Operate	T	R
TmASt	CSD	Active curve characteristic		O
Settings				
TmACrv	CURVE	Operating Curve Type		R
StrVal	ASG	Start Value		R
TmMult	ASG	Time Dial Multiplier		O
MinOpTmms	ING	Minimum Operate Time		R
MaxOpTmms	ING	Maximum Operate Time		R
OpDlTmms	ING	Operate Delay Time		R
AOpDlTmms	ING	ENEL Additional/Accelerated Operate Delay Time		R
TypRsCrv	ING	Type Reset Curve		O
RsDlTmms	ING	Reset Delay Time		R
DirMod	ING	Directional Mode		R
PAccelEna	SPG	ENEL Protection Acceleration Enabling		R
PBst	SPG	ENEL Protection Behaviour (1=Str 2= Str+Op)		R
FFSEna	SPG	ENEL Fast Fault Selection Enabling (Participation in the Logic Selectivity)		R
Bl2ndHEna	SPG	ENEL Block due to 2nd H Enabling		R
TmACStrVal	ASG	ENEL Active curve characteristic Start Value (Ip for Td curve)		R
TmACOpDlTm	ING	ENEL Active curve characteristic Operate Delay Time (Tp for Td curve)		R
CLPMod	ING	ENEL Cold Load Pickup Mode		R
ACLPOpPer	ASG	ENEL Accelerated and Cold Load Pickup Operating Period		R
CLPCrVlTi	ASG	ENEL Cold Load Pickup Current Value (Ti)		R
CLPCrVlTd	ASG	ENEL Cold Load Pickup Current Value (Td)		R

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of this protection stage (base and accelerated)

Common Logical Node Information→ OpCntRs: to count and store the number of operations of this stage (base and accelerated)

Status Information→ Str: for issuing the Start signal of this stage (base and accelerated)

Status Information→ Op: for issuing the Tripping signal of this stage (base only)

Status Information→ AOp: for sending the Tripping signal of this stage (accelerated only)

Settings→ TmACrv: for setting the **IEC curve type** in case the stage is Td (base only) or if the stage is **Ti**:

a. 9 = NIT (IEC Normal Inverse)

b. 10 = VIT (IEC Very Inverse)

c. 12 = EIT (IEC Extremely Inverse)

d. 14 = LIT (IEC Long – Time Inverse)

e. 15 = Ti (IEC Definite Time)

Settings→ StrVal: for setting the current threshold of this stage (base and accelerated) when Ti (min..max; step; default; m.u.)

Settings→ MinOpTmms: for setting the minimum duration time of the accelerated (only) stage (min..max; step; default; m.u.)

Settings→ MaxOpTmms: for setting the backup time of the stage **TrOC.S3** when Ti (min..max; step; default; m.u.)

Settings→ OpDlTmms: for setting the operate delay time of the stage **TOC.S3** (base only) when Ti (min..max; step; default; m.u.)

Settings→ AOpDlTmms: for setting the operate delay time of the stage **TOC.S3_c** (accelerated only) when Ti (min..max; step; default; m.u.)

Settings→ RsDlTmms: for setting the drop-Off timer of the stage **OC.S3** (0..100s, 0,01, 0)

Settings → DirMod: for setting the directionality of this **OC** stage (according to the related REDR settings and the status of the REVERSAL signal form the UP2020 Lite):

f. 1 = 51 non-directional (Default)

g. 2 = 67 Forward

Settings→ PAccelEna: for enabling the dual time calibration (acceleration) of this stage:

h. 0 = base only

i. 1 = base + accelerated

Settings→ PBst: for setting the behaviour of this stage (base and accelerated):

j. 0 = Start + Operate

k. 1 = Start only

Settings → FFSEna: for setting the participation in the Logic Selectivity function (publishing and subscribing) of this stage (base and accelerated):

l. 0 = excluded

m. 1 = participating

Settings → Bl2ndHEna: for allowing the blocking, due to 2nd harmonic restraint protection, of this stage (base and accelerated):

n. 0 = not blockable

o. 1 = stage Sx blockable due to 2nd harmonic

Settings → TmACStrVal: for setting the Ip of the curve in case of Td stage (base only) (min..max; step; default; m.u.)

Settings → TmACOpDlTm: for setting the Tp of the curve in case of Td stage (base only) (min..max; step; default; m.u.)

Settings → CLPMod: for setting the mode of the Cold Load Pickup function for this stage:

p. 0 = Off (Default)

q. 1 = On – Stage Block

r. 2 = On – Stage Modification

Settings → ACLPOpPer: for setting the Operating Period of the Acceleration or of the Cold Load Pickup for this stage (0..100;0.01;0.1 sec)

Settings → CLPCrVITi: for setting the Cold Load Pickup Current Value (0,02..3;0,02; 0,6 p.u.) when Ti

Settings → CLPCrVITd: for setting the Cold Load Pickup Current Value (0,02..3;0,02; 0,6 p.u.) when Td.

The following REDR LN models the directional data and characteristics of the (base and accelerated) OC.S3 stage only when directional (67).

Table 33 – type:REDR1 - prefix: POCS3 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Status Information				
Dir	ACD	Direction		M
Settings				
ChrAng	ASG	Characteristic Angle		R
AChrAng	ASG	ENEL Additional Characteristic Angle		R
MinFwdAng	ASG	Minimum Phase Angle in Forward Direction		R
MinRvAng	ASG	Minimum Phase Angle in Reverse Direction		O
MaxFwdAng	ASG	Maximum Phase Angle in Forward Direction		O
MaxRvAng	ASG	Maximum Phase Angle in Reverse Direction		O
BlkValA	ASG	Minimum operating current	-	O
BlkValV	ASG	Minimum operating voltage	-	O
PolQty	ING	Polarising Quantity		O
MinPPV	ASG	Min Phase-Phase Voltage		O

NOTES:

Settings→ ChrAng: for setting the bisector of the Tripping Sector of the OC.S3 (Ti) stage (0..360; 1, 0)

Settings→ AChrAng: for setting the Additional bisector of the Tripping Sector of the OC.S3 (Td) stage (0..360; 1, 0)

Settings→ MinFwdAng: for setting the halfwidth of the Tripping Sector of the OC.S3 (Ti+Td) stage (0..90,1,88)**.**

7.2.5.5 OC.S4 (Ti+Td) stage with dual time calibration

Table 34 – type:PEOC2 - prefix: POCS4 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Str	ACD	Start		M
Op	ACT	Operate	T	M
AOp	ACT	ENEL Additional/Accelerated Operate	T	R
TmASt	CSD	Active curve characteristic		O

Settings				
TmACrv	CURVE	Operating Curve Type		R
StrVal	ASG	Start Value		R
TmMult	ASG	Time Dial Multiplier		O
MinOpTmms	ING	Minimum Operate Time		R
MaxOpTmms	ING	Maximum Operate Time		R
OpDlTmms	ING	Operate Delay Time		R
AOpDlTmms	ING	ENEL Additional/Accelerated Operate Delay Time		R
TypRsCrv	ING	Type Reset Curve		O
RsDlTmms	ING	Reset Delay Time		R
DirMod	ING	Directional Mode		R
PAccelEna	SPG	ENEL Protection Acceleration Enabling		R
PBst	SPG	ENEL Protection Behaviour (1=Str 2= Str+Op)		R
FFSEna	SPG	ENEL Fast Fault Selection Enabling (Participation in the Logic Selectivity)		R
Bl2ndHEna	SPG	ENEL Block due to 2nd H Enabling		R
TmACStrVal	ASG	ENEL Active curve characteristic Start Value (Ip for Td curve)		R
TmACOpDlTm	ING	ENEL Active curve characteristic Operate Delay Time (Tp for Td curve)		R
CLPMod	ING	ENEL Cold Load Pickup Mode		R
ACLPOpPer	ASG	ENEL Accelerated and Cold Load Pickup Operating Period		R
CLPCrVlTi	ASG	ENEL Cold Load Pickup Current Value (Ti)		R
CLPCrVlTd	ASG	ENEL Cold Load Pickup Current Value (Td)		R

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of this protection stage (base and accelerated)

Common Logical Node Information→ OpCntRs: to count and store the number of operations of this stage (base and accelerated)

Status Information→ Str: for issuing the Start signal of this stage (base and accelerated)

Status Information→ Op: for issuing the Tripping signal of this stage (base only)

Status Information→ AOp: for sending the Tripping signal of this stage (accelerated only)

Settings→ TmACrv: for setting the **IEC curve type** in case the stage is Td (base only) or if the stage is **Ti**:

a. 9 = NIT (IEC Normal Inverse)

b. 10 = VIT (IEC Very Inverse)

c. 12 = EIT (IEC Extremely Inverse)

d. 14 = LIT (IEC Long – Time Inverse)

e. 15 = Ti (IEC Definite Time)

Settings→ StrVal: for setting the current threshold of this stage (base and accelerated) when Ti (min..max; step; default; m.u.)

Settings→ MinOpTmms: for setting the minimum duration time of the accelerated (only) stage (min..max; step; default; m.u.)

Settings→ MaxOpTmms: for setting the backup time of the stage **TrOC.S4** when Ti (min..max; step; default; m.u.)

Settings→ OpDlTmms: for setting the operate delay time of the stage **TOC.S4** (base only) when Ti (min..max; **step**; default; m.u.)

Settings→ AOpDlTmms: for setting the operate delay time of the stage **TOC.S4_c** (accelerated only) when Ti (min..max; step; default; m.u.)

Settings→ RsDITmms: for setting the drop-Off timer of the stage **OC.S4** (0..100s, 0,01, 0)

Settings → DirMod: for setting the directionality of this **OC** stage (according to the related REDR settings and the status of the REVERSAL signal form the UP2020 Lite):

f. 1 = 51 non-directional (Default)

g. 2 = 67 Forward

Settings→ PAccelEna: for enabling the dual time calibration (acceleration) of this stage:

h. 0 = base only

i. 1 = base + accelerated

Settings→ PBst: for setting the behaviour of this stage (base and accelerated):

j. 0 = Start + Operate

k. 1 = Start only

Settings → FFSEna: for setting the participation in the Logic Selectivity function (publishing and subscribing) of this stage (base and accelerated):

l. 0 = excluded

m. 1 = participating

Settings → BI2ndHEna: for allowing the blocking, due to 2nd harmonic restraint protection, of this stage (base and accelerated):

n. 0 = not blockable

o. 1 = stage Sx blockable due to 2nd harmonic

Settings → TmACStrVal: for setting the Ip of the curve in case of Td stage (base only) (min..max; step; default; m.u.)

Settings → TmACOpDITm: for setting the Tp of the curve in case of Td stage (base only) (min..max; step; default; m.u.)

Settings → CLPMod: for setting the mode of the Cold Load Pickup function for this stage:

p. 0 = Off (Default)

q. 1 = On – Stage Block

r. 2 = On – Stage Modification

Settings → ACLPOpPer: for setting the Operating Period of the Acceleration or of the Cold Load Pickup for this stage (0..100;0.01;0.1 sec)

Settings → CLPCrVITi: for setting the Cold Load Pickup Current Value (0,02..3;0,02; 0,6 p.u.) when Ti

Settings → CLPCrVITd: for setting the Cold Load Pickup Current Value (0,02..3;0,02; 0,6 p.u.) when Td.

The **following** REDR LN models the directional data and characteristics of the (base and accelerated) OC.S4 stage only when directional (67).

Table 35 – type:REDR1 - prefix: POCS4 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Status Information				
Dir	ACD	Direction		M
Settings				

ChrAng	ASG	Characteristic Angle		R
AChrAng	ASG	ENEL Additional Characteristic Angle		R
MinFwdAng	ASG	Minimum Phase Angle in Forward Direction		R
MinRvAng	ASG	Minimum Phase Angle in Reverse Direction		O
MaxFwdAng	ASG	Maximum Phase Angle in Forward Direction		O
MaxRvAng	ASG	Maximum Phase Angle in Reverse Direction		O
BlkValA	ASG	Minimum operating current	-	O
BlkValV	ASG	Minimum operating voltage	-	O
PolQty	ING	Polarising Quantity		O
MinPPV	ASG	Min Phase-Phase Voltage		O

NOTES:

Settings→ ChrAng: for setting the bisector of the Tripping Sector of the OC.S4 (Ti) stage (0..360; 1, 0)

Settings→ AChrAng: for setting the Additional bisector of the Tripping Sector of the OC.S4 (Td) stage (0..360; 1, 0)

Settings→ MinFwdAng: for setting the halfwidth of the Tripping Sector of the OC.S4 (Ti+**Td**) stage (0..90,1,88).

7.2.6 Directional Earth Overcurrent protection (67N)

The 67N directional earth overcurrent protection must detect earth faults downstream of the installation point in grids with insulated or compensated neutral.

This protection consists of three stages.

The reversal of the tripping sectors conceptually belongs to the automation logics, in particular after a reconfiguration of the network topology to isolate a faulty section. The reversal is achieved using a single (internal) signal and its description will be done in 7.4.2.

7.2.6.1 P67N general settings

Table 36 – type:GAPC5 - prefix: GS67N - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Controls				
SPCSO1	SPC	Single point controllable status output (1)		R
SPCSO2	SPC	Single point controllable status output (2)		R
SPCSO3	SPC	Single point controllable status output (3)		R
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
Auto	SPS	Automatic operation		O
Str	ACD	Start		M
Op	ACT	Operate	T	M
Settings				
StrVal	ASG	Start Value		R

NOTES:

Common Logical Node Information → OpCntRs: to count and store the number of P67N general reconfigurations

Controls → SPCSO1: for setting the measuring operating mode of the P67N stages:

a. 0 = current (Default)

b. 1 = current*cosfi

Controls → SPCSO2: for setting the Voltage reference type of the P67N stages:

c. 0 = Calculated Residual

d. 1 = Open Delta (Default)

Controls → SPCSO3: for setting the dead band of the P67N stages:

e. 0 = Off (Default)

f. 1 = On

Settings → StrVal: for setting the dead band multiplier of the P67N stages (1.5..10; 0.1; 1.5).

7.2.6.2 67N.S1 (Ti+Td) stage with dual time calibration for compensated neutral network

Table 37 – type:PEOC1 - prefix: N671 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/ O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Str	ACD	Start		M
Op	ACT	Operate	T	M
AOp	ACT	ENEL Additional/Accelerated Operate	T	R
TmASt	CSD	Active curve characteristic		O
Settings				
TmACrv	CURVE	Operating Curve Type		R
StrVal	ASG	Start Value		R
TmMult	ASG	Time Dial Multiplier		O
MinOpTmms	ING	Minimum Operate Time		R
MaxOpTmms	ING	Maximum Operate Time		R
OpDlTmms	ING	Operate Delay Time		R
AOpDlTmms	ING	ENEL Additional/Accelerated Operate Delay Time		R
TypRsCrv	ING	Type Reset Curve		O
RsDlTmms	ING	Reset Delay Time		R
DirMod	ING	Directional Mode		O
PAccelEna	SPG	ENEL Protection Acceleration Enabling		R
PBst	SPG	ENEL Protection Behaviour (1=Str 2= Str+Op)		R
FFSEna	SPG	ENEL Fast Fault Selection Enabling (Participation in the Logic Selectivity)		R
Bl2ndHEna	SPG	ENEL Block due to 2nd H Enabling		R
TmACStrVal	ASG	ENEL Active curve characteristic Start Value (Ip for Td curve)		R
TmACOpDlTm	ING	ENEL Active curve characteristic Operate Delay Time (Tp for Td curve)		R
CLPMod	ING	ENEL Cold Load Pickup Mode		R
ACLPOpPer	ASG	ENEL Accelerated and Cold Load Pickup Operating Period		R
CLPCrVlTi	ASG	ENEL Cold Load Pickup Current Value (Ti)		R

CLPCrVITd	ASG	ENEL Cold Load Pickup Current Value (Td)		R

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of this protection stage (base and accelerated)

Common Logical Node Information→ OpCntRs: to count and store the number of operations of this stage (base and accelerated)

Status Information→ Str: for issuing the Start signal of this stage (base and accelerated)

Status Information→ Op: for issuing the Tripping signal of this stage (base only)

Status Information→ AOp: for sending the Tripping signal of this stage (accelerated only)

Settings→ TmACrv: for setting the **IEC curve type** in case the stage is Td (base only) or if the stage is **Ti**:

a. 9 = NIT (IEC Normal Inverse)

b. 10 = VIT (IEC Very Inverse)

c. 12 = EIT (IEC Extremely Inverse)

d. 14 = LIT (IEC Long – Time Inverse)

e. 15 = Ti (IEC Definite Time)

Settings→ StrVal: for setting the current threshold of this stage (base and accelerated) when Ti (min..max; step; default; m.u.)

Settings→ MinOpTmms: for setting the minimum duration time of the accelerated (only) **stage** (min..max; step; default; m.u.)

Settings→ MaxOpTmms: for setting the backup time of the stage **Tr67N.S1** when Ti (min..max; step; default; m.u.)

Settings→ OpDlTmms: for setting the operate delay time of the stage **T67N.S1** (base only) when Ti (min..max; step; default; m.u.)

Settings→ AOpDlTmms: for setting the operate delay time of the stage **T67N.S1_c** (accelerated only) when Ti (min..max; step; default; m.u.)

Settings→ RsDlTmms: for setting the drop-Off timer of the stage **67N.S1** (0..100s, 0,01, 0)

Settings→ PAccelEna: for enabling the dual time calibration (acceleration) of this stage:

f. 0 = base only

g. 1 = base + accelerated

Settings→ PBst: for setting the behaviour of this stage (base and accelerated):

h. 0 = Start + Operate

i. 1 = Start only

Settings → FFSEna: for setting the participation in the Logic Selectivity function (publishing and subscribing) of this stage (base and accelerated):

j. 0 = excluded

k. 1 = participating

Settings → BI2ndHEna: for allowing the blocking, due to 2nd harmonic restraint protection, of this stage (base and accelerated):

l. 0 = not blockable

m. 1 = stage Sx blockable due to 2nd harmonic

Settings → TmACStrVal: for setting the Ip of the curve in case of Td stage (base only) (min..max; step; default; m.u.)

Settings → TmACOpDITm: for setting the Tp of the curve in case of Td stage (base only) (min..max; step; default; m.u.)

Settings → CLPMod: for setting the mode of the Cold Load Pickup function for this stage:

n. 0 = Off (Default)

o. 1 = On – Stage Block

p. 2 = On – Stage Modification

Settings → ACLPOpPer: for setting the Operating Period of the Acceleration or of the Cold Load Pickup for this stage (0..100;0.01;0.1 sec)

Settings → CLPCrVITi: for setting the Cold Load Pickup Current Value (0,02..3;0,02; 0,6 p.u.) when Ti

Settings → CLPCrVITd: for setting the Cold Load Pickup Current Value (0,02..3;0,02; 0,6 p.u.) when Td.

The following REDR LN models the directional data and characteristics of the 67.S1 stage (base and accelerated).

Table 38 – type:REDR2 - prefix: N671 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Status Information				
Dir	ACD	Direction		M
Settings				
ChrAng	ASG	Characteristic Angle		R
AChrAng	ASG	ENEL Additional Characteristic Angle		R
MinFwdAng	ASG	Minimum Phase Angle in Forward Direction		R
MinRvAng	ASG	Minimum Phase Angle in Reverse Direction		O
MaxFwdAng	ASG	Maximum Phase Angle in Forward Direction		O
MaxRvAng	ASG	Maximum Phase Angle in Reverse Direction		O
BlkValA	ASG	Minimum operating current		R
BlkValV	ASG	Minimum operating voltage		R
PolQty	ING	Polarising Quantity		O
MinPPV	ASG	Min Phase-Phase Voltage		O

NOTES:

Settings→ ChrAng: for setting the bisector of the Tripping Sector of the 67N.S1 (Ti) stage (0..360; 1, 0)

Settings→ AChrAng: for setting the bisector of the Tripping Sector of the 67N.S1 (Td) stage (0..360; 1, 0)

Settings→ MinFwdAng: for setting the halfwidth of the Tripping Sector of the 67N.S1 (Ti+Td) stage (0..90,1,88)

Settings→ BlkValA: for setting the residual current value 3**Io** of the 67N.S1 (Ti+Td) stage

Settings→ BlkValV: for setting the residual voltage value 3**Vo** of the 67N.S1 (Ti+Td) stage.

7.2.6.3 67N.S2 (Ti+Td) stage with dual time calibration for isolated neutral network

Table 39 – type:PEOC1 - prefix: N672 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				

		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Str	ACD	Start		M
Op	ACT	Operate	T	M
AOp	ACT	ENEL Additional/Accelerated Operate	T	R
TmASt	CSD	Active curve characteristic		O
Settings				
TmACrv	CURVE	Operating Curve Type		R
StrVal	ASG	Start Value		R
TmMult	ASG	Time Dial Multiplier		O
MinOpTmms	ING	Minimum Operate Time		R
MaxOpTmms	ING	Maximum Operate Time		R
OpDlTmms	ING	Operate Delay Time		R
AOpDlTmms	ING	ENEL Additional/Accelerated Operate Delay Time		R
TypRsCrv	ING	Type Reset Curve		O
RsDlTmms	ING	Reset Delay Time		R
DirMod	ING	Directional Mode		O
PAccelEna	SPG	ENEL Protection Acceleration Enabling		R
PBst	SPG	ENEL Protection Behaviour (1=Str 2= Str+Op)		R
FFSEna	SPG	ENEL Fast Fault Selection Enabling (Participation in the Logic Selectivity)		R
Bl2ndHEna	SPG	ENEL Block due to 2nd H Enabling		R
TmACStrVal	ASG	ENEL Active curve characteristic Start Value (Ip for Td curve)		R
TmACOpDlTm	ING	ENEL Active curve characteristic Operate Delay Time (Tp for Td curve)		R
CLPMod	ING	ENEL Cold Load Pickup Mode		R
ACLPOpPer	ASG	ENEL Accelerated and Cold Load Pickup Operating Period		R
CLPCrVlTi	ASG	ENEL Cold Load Pickup Current Value (Ti)		R
CLPCrVlTd	ASG	ENEL Cold Load Pickup Current Value (Td)		R

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of this protection stage (base and accelerated)

Common Logical Node Information→ OpCntRs: to count and store the number of operations of this stage (base and accelerated)

Status Information→ Str: for issuing the Start signal of this stage (base and accelerated)

Status Information→ Op: for issuing the Tripping signal of this stage (base only)

Status Information→ AOp: for sending the Tripping signal of this stage (accelerated only)

Settings→ TmACrv: for setting the **IEC curve type** in case the stage is Td (base only) or if the stage is **Ti**:

a. 9 = NIT (IEC Normal Inverse)

b. 10 = VIT (IEC Very Inverse)

c. 12 = EIT (IEC Extremely Inverse)

d. 14 = LIT (IEC Long – Time Inverse)

e. 15= Ti (IEC Definite Time)

Settings→ StrVal: for setting the current threshold of this stage (base and accelerated) when Ti (min..max; step; default; m.u.)

Settings→ MinOpTmms: for setting the minimum duration time of the accelerated (only) stage (min..max; step; default; m.u.)

Settings→ MaxOpTmms: for setting the backup time of the stage **Tr67N.S2** when Ti (min..max; step; default; m.u.)

Settings→ OpDlTmms: for setting the operate delay time of the stage **T67N.S2** (base only) when Ti (min..max; step; default; m.u.)

Settings→ AOpDlTmms: for setting the operate delay time of the stage **T67N.S2_c** (accelerated only) when Ti (min..max; step; default; m.u.)

Settings→ RsDlTmms: for setting the drop-Off timer of the stage **67N.S2** (0..100s, 0,01, 0)

Settings→ PAccelEna: for enabling the dual time calibration (acceleration) of this stage:

f. 0 = base only

g. 1 = base + accelerated

Settings→ PBst: for setting the behaviour of this stage (base and accelerated):

h. 0 = Start + Operate

i. 1 = Start only

Settings → FFSEna: for setting the participation in the Logic Selectivity function (publishing and subscribing) of this stage (base and accelerated):

j. 0 = excluded

k. 1 = participating

Settings → Bl2ndHEna: for allowing the blocking, due to 2nd harmonic restraint protection, of this stage (base and accelerated):

l. 0 = not blockable

m. 1 = stage Sx blockable due to 2nd harmonic

Settings → TmACStrVal: for setting the Ip of the curve in case of Td stage (base only) (min..max; step; default; m.u.)

Settings → TmACOpDlTm: for setting the Tp of the curve in case of Td stage (base only) (min..max; step; default; m.u.)

Settings → CLPMod: for setting the mode of the Cold Load Pickup function for this stage:

n. 0 = Off (Default)

o. 1 = On – Stage Block

p. 2 = On – Stage Modification

Settings → ACLPOpPer: for setting the Operating Period of the Acceleration or of the Cold Load Pickup for this stage (0..100;0.01;0.1 sec)

Settings → CLPCrVlTi: for setting the Cold Load Pickup Current Value (0,02..3;0,02; 0,6 p.u.) when Ti

Settings → CLPCrVlTd: for setting the Cold Load Pickup Current Value (0,02..3;0,02; 0,6 p.u.) when Td.

The following REDR LN models the directional data and characteristics of the 67N.S2 stage (base and accelerated).

Table 40 – type:REDR2 - prefix: N672 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Status Information				

Dir	ACD	Direction		M
Settings				
ChrAng	ASG	Characteristic Angle		R
AChrAng	ASG	ENEL Additional Characteristic Angle		R
MinFwdAng	ASG	Minimum Phase Angle in Forward Direction		R
MinRvAng	ASG	Minimum Phase Angle in Reverse Direction		O
MaxFwdAng	ASG	Maximum Phase Angle in Forward Direction		O
MaxRvAng	ASG	Maximum Phase Angle in Reverse Direction		O
BlkValA	ASG	Minimum operating current		R
BlkValV	ASG	Minimum operating voltage		R
PolQty	ING	Polarising Quantity		O
MinPPV	ASG	Min Phase-Phase Voltage		O

NOTES:

Settings→ ChrAng: for setting the bisector of the Tripping Sector of the 67N.S2 (Ti) stage (0..360; 1, 0)

Settings→ AChrAng: for setting the bisector of the Tripping Sector of the 67N.S2 (Td) stage (0..360; 1, 0)

Settings→ MinFwdAng: for setting the halfwidth of the Tripping Sector of the 67N.S2 (Ti+Td) stage (0..90,1,88)

Settings→ BlkValA: for setting the residual current value 3**Io** of the 67N.S2 (Ti+Td) stage

Settings→ BlkValV: for setting the residual voltage value 3**Vo** of the 67N.S2 (Ti+Td) stage.

7.2.6.4 67N.S3 (Ti+Td) stage with dual time calibration for double earth fault

Table 41 – type:PEOC1 - prefix: N673 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/ O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Str	ACD	Start		M
Op	ACT	Operate	T	M
AOp	ACT	ENEL Additional/Accelerated Operate	T	R
TmASt	CSD	Active curve characteristic		O
Settings				
TmACrv	CURVE	Operating Curve Type		R
StrVal	ASG	Start Value		R
TmMult	ASG	Time Dial Multiplier		O
MinOpTmms	ING	Minimum Operate Time		R
MaxOpTmms	ING	Maximum Operate Time		R
OpDlTmms	ING	Operate Delay Time		R
AOpDlTmms	ING	ENEL Additional/Accelerated Operate Delay Time		R
TypRsCrv	ING	Type Reset Curve		O
RsDlTmms	ING	Reset Delay Time		R
DirMod	ING	Directional Mode		O
PAccelEna	SPG	ENEL Protection Acceleration Enabling		R
PBst	SPG	ENEL Protection Behaviour (1=Str 2= Str+Op)		R
FFSEna	SPG	ENEL Fast Fault Selection Enabling (Participation in the Logic Selectivity)		R
Bl2ndHEna	SPG	ENEL Block due to 2nd H Enabling		R

TmACStrVal	ASG	ENEL Active curve characteristic Start Value (Ip for Td curve)		R
TmACOpDITm	ING	ENEL Active curve characteristic Operate Delay Time (Tp for Td curve)		R
CLPMod	ING	ENEL Cold Load Pickup Mode		R
ACLPOpPer	ASG	ENEL Accelerated and Cold Load Pickup Operating Period		R
CLPCrVITi	ASG	ENEL Cold Load Pickup Current Value (Ti)		R
CLPCrVITd	ASG	ENEL Cold Load Pickup Current Value (Td)		R

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of this protection stage (base and accelerated)

Common Logical Node Information→ OpCntRs: to count and store the number of operations of this stage (base and accelerated)

Status Information→ Str: for issuing the Start signal of this stage (base and accelerated)

Status Information→ Op: for issuing the Tripping signal of this stage (base only)

Status Information→ AOp: for sending the Tripping signal of this stage (accelerated only)

Settings→ TmACrv: for setting the **IEC curve type** in case the stage is Td (base only) or if the stage is **Ti**:

a. 9 = NIT (IEC Normal Inverse)

b. 10 = VIT (IEC Very Inverse)

c. 12 = EIT (IEC Extremely Inverse)

d. 14 = LIT (IEC Long – Time Inverse)

e. 15 = Ti (IEC Definite Time)

Settings→ StrVal: for setting the current threshold of this stage (base and accelerated) when Ti (min..max; step; default; m.u.)

Settings→ MinOpTmms: for setting the minimum duration time of the accelerated (only) stage (min..max; step; default; m.u.)

Settings→ MaxOpTmms: for setting the backup time of the stage **Tr67N.S3** when Ti (min..max; step; default; m.u.)

Settings→ OpDITmms: for setting the operate delay time of the stage **T67N.S3** (base only) when Ti (min..max; step; default; m.u.)

Settings→ AOpDITmms: for setting the operate delay time of the stage **T67N.S3_c** (accelerated only) when Ti (min..max; step; default; m.u.)

Settings→ RsDITmms: for setting the drop-Off timer of the stage **67N.S3** (0..100s, 0,01, 0)

Settings→ PAccelEna: for enabling the dual time calibration (acceleration) of this stage:

f. 0 = base only

g. 1 = base + accelerated

Settings→ PBst: for setting the behaviour of this stage (base and accelerated):

h. 0 = Start + Operate

i. 1 = Start only

Settings → FFSEna: for setting the participation in the Logic Selectivity function (publishing and subscribing) of this stage (base and accelerated):

j. 0 = excluded

k. 1 = participating

Settings → BI2ndHEna: for allowing the blocking, due to 2nd harmonic restraint protection, of this stage (base and accelerated):

l. 0 = not blockable

m. 1 = stage Sx blockable due to 2nd harmonic

Settings → TmACStrVal: for setting the Ip of the curve in case of Td stage (base only) (min..max; step; default; m.u.)

Settings → TmACOpDITm: for setting the Tp of the curve in case of Td stage (base only) (min..max; step; default; m.u.)

Settings → CLPMod: for setting the mode of the Cold Load Pickup function for this stage:

n. 0 = Off (Default)

o. 1 = On – Stage Block

p. 2 = On – Stage Modification

Settings → ACLPOpPer: for setting the Operating Period of the Acceleration or of the Cold Load Pickup for this stage (0..100;0.01;0.1 sec)

Settings → CLPCrVITi: for setting the Cold Load Pickup Current Value (0,02..3;0,02; 0,6 p.u.) when Ti

Settings → CLPCrVITd: for setting the Cold Load Pickup Current Value (0,02..3;0,02; 0,6 p.u.) when Td.

The following REDR LN models the directional data and characteristics of the 67N.S3 stage (base and accelerated).

Table 42 – type:REDR2 - prefix: N673 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Status Information				
Dir	ACD	Direction		M
Settings				
ChrAng	ASG	Characteristic Angle		R
AChrAng	ASG	ENEL Additional Characteristic Angle		R
MinFwdAng	ASG	Minimum Phase Angle in Forward Direction		R
MinRvAng	ASG	Minimum Phase Angle in Reverse Direction		O
MaxFwdAng	ASG	Maximum Phase Angle in Forward Direction		O
MaxRvAng	ASG	Maximum Phase Angle in Reverse Direction		O
BlkValA	ASG	Minimum operating current		R
BlkValV	ASG	Minimum operating voltage		R
PolQty	ING	Polarising Quantity		O
MinPPV	ASG	Min Phase-Phase Voltage		O

NOTES:

Settings→ ChrAng: for setting the bisector of the Tripping Sector of the 67N.S3 (Ti) stage (0..360; 1, 0)

Settings→ AChrAng: for setting the bisector of the Tripping Sector of the 67N.S3 (Td) stage (0..360; 1, 0)

Settings→ MinFwdAng: for setting the halfwidth of the Tripping Sector of the 67N.S3 stage (0..90,1,88)

Settings→ BlkValA: for setting the residual current value 3**Io** of the 67N.S3 stage

Settings→ BlkValV: for setting the residual voltage value 3**Vo** of the 67N.S3 stage.

7.2.7 Conditioning of the Str and/or Op for 51N, OC and 67N stages

This LN is used to connect the Start and Operate outputs of one or more protections stages to a common signal that will be notified to the client and, case by case, will trip the MV Circuit Breaker. It models the conditioning of the start and trip with the following rules:

a. The Str is the sum of OC.Sn (n=1…4) and 51N.Sm (m=1,2) and 67N.S3 Starts;

b. The Op1 is the sum of OC.Sn (n=1…4) Operate;

c. The Str2 is the sum of the 67N.Sn (n=1… 3),of:

- Op 67N.Sn,
- AOp 67N.Sn.

Table 43 – type: GAPC10 – prefix: OCSxC – LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local Operation		O
OpCntRs	INC	Resetable operation counter		R
Controls				
SPCSO	SPC	Single point controllable status output		O
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status information				
Auto	SPS	Automatic Operation		O
Str1	ACD	Start (1)		M
Op1	ACT	Operate (1)	T	M
Str2	ACD	Start (2)		R
Op2	ACT	Operate (2)	T	R
Op3	ACT	Operate (3)	T	R
Op4	ACT	Operate (4)	T	R
Settings				
StrVal	ASG	Start value		O

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of events occured

Status Information→ Str1: for issuing the start triggered by one or more 51N, OC and 67N.S3 protection stages

Status Information→ Str2: for issuing the start triggered by one or more 67N protection stages

Status Information→ Op2: for issuing the Operate combination of 67N.S1 Op (base and accelerated)

Status Information→ Op3: for issuing the Operate combination of 67N.S2 Op (base and accelerated)

Status Information→ Op4: for issuing the Operate combination of 67N.S3 Op (base and accelerated)

7.2.8 Conditioning of the Str for 67N stages

This LN is used to connect the Start outputs of one or more protections stages to a common signal that will be notified to the client.

This LN models the conditioning of the start as the sum of 67N.Sn (n=1…3) Starts.

Table 44 – type:PTRC1 - prefix: N67Sum - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Tr	ACT	Trip		(C) O
Op	ACT	Operate (combination of subscribed Op from protection functions)		(C) R
Str	ACD	Sum of all starts of all connected Logical Nodes		R
Settings				
TrMod	ING	Trip Mode		O
TrPlsTmms	ING	Trip Pulse Time		O

Condition C: At least one of the two status information (Tr, Op) shall be used.

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of operations of the 67N protections due to a fault detection;

Status Information→ Str: for notifying the start triggered by one or more 67N protection stages**.**

7.2.9 Directional Earth Overcurrent protection: "Arcing Ground" detection (67N.S4)

The protection allows the "Arcing Ground" detection according to internal logics based on the settings of timers and on the state of 67N.S1..S3. It trips the MV Circuit Breaker; the trip is reported to the MV/LV DS Client). This protection consists of one stage only.

7.2.9.1 67N.S4 stage

Table 45 – type:GAPC1 - prefix: N674 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Controls				
SPCSO	SPC	Single point controllable status output		O
DPCSO	DPC	Double point controllable status output		O
ISCSO1	INC	Integer status controllable status output (1)		R
ISCSO2	INC	Integer status controllable status output (2)		R
ISCSO3	INC	Integer status controllable status output (3)		R
Status Information				
Auto	SPS	Automatic operation		O
Str	ACD	Start		M
Op	ACT	Operate	T	M
Settings				
StrVal	ASG	Start Value		O

NOTES:

Common Logical Node Information→ Mod: for handling the Enabling/Disabling command (1/5) of this protection stage (default: Enabled)

Common Logical Node Information→ OpCntRs: to count and store the number of operations of this stage

Controls → ISCSO1: for setting the timer T1 of the 67N.S4 internal logics

Controls → ISCSO2: for setting the timer T2 of the 67N.S4 internal logics

Controls → ISCSO3: for setting the timer T of the 67N.S4 internal logics

Status Information→ Str: for issuing the Start signal of 67N.S4

Status Information→ Op: for issuing the Tripping signal of 67N.S4.

7.2.10 Directional Active Overpower protection (32P)

This function, basing on the configured behaviour (according to GSTP011), can issue a signal both to the Control Center and to the relevant Distributed Generation (this information is issued to possible IDC_DER via GOOSE). This protection consists of one stage only.

Table 46 – type:PEOP1 - prefix: P32PS1 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Str	ACD	Start		M
Op	ACT	Operate	T	M
DGCtl	SPG	ENEL Protection Distributed Generation Control		R
Settings				
DirMod	ING	Directional Mode		R
StrVal	ASG	Start Value		R
OpDlTmms	ING	Operate Delay Time		R
OpAdDlTmms	ING	Additional Operate delay time		R
RsDlTmms	ING	Reset Delay Time		R
PBst	SPG	ENEL Protection Behaviour (1=Str 2= Str+Op)		O
FFSEna	SPG	ENEL Fast Fault Selection Enabling (Partecipation in the Logic Selectivity)		O
PFunB	ING	ENEL Protection Functional Behaviour (Local and towards DER plant)		R

NOTES:

Common Logical Node Information→ Mod: for handling the Enabling/Disabling command (1/5) of this protection stage (default: Disabled)

Common Logical Node Information→ OpCntRs: to count and store the number of operations of this stage

Status Information→ Str: for issuing the Start signal of this stage

Status Information→ Op: for issuing the Tripping signal of this stage

Controls → DGCtl: (ready) for issuing the request of Active Power Reduction to DER after the exceeding of the P32.S1 threshold (ref. GSTP011)

Settings→ DirMod: for setting the operating mode according to the direction of the active power flow:

a. 1 = operation based on the magnitude of the P (Non Directional)

b. 2 = operation based on the positive direction of the P (Direct)

c. 3 = operation based on the negative direction of the P (Inverse)

Settings→ StrVal: for setting the active power P threshold of the **32P.S1** stage (0..1; 0,0025; 0,5)

Settings→ OpDlTmms: for setting the operate delay time for the **P32.S1** (0.05..10s; 0.01s; 1s)

Settings→ OpAdDlTmms: for setting the additional operate delay time for the **P32.S1** (10..60s; 1s; 30s)

Settings→ RsDlTmms: for setting the reset delay for the **P32.S1** (0..100s; 0.01s; 0s)

Settings→ PFunB: for setting the functional behavior of the **32P.S1** stage:

d. **0** = notification to the DS Client only;

e. **1** = notification to the DS Client and to the DER (+ optionally the Trip Command to the Circuit Breaker)

f. **2** = Trip Command to the Circuit Breaker and notification to the DS Client.

This LN is ready to issue via GOOSE the Active Power Reduction command to the possible IDC_DER.

7.2.11 Discrimination of INRUSH currents (2nd H) protection

This protection doesn't issue tripping commands to the MV Circuit Breaker. It blocks (for a time T_ini_2ndH) the 51N.S1..S3, OC.S1..S4 and 67N.S1..S3 protections to avoid unwanted operations when the 2nd harmonic current overcomes a predetermined fraction of the fundamental component due to the energization of the transformers installed along the feeder.

Table 47 – type:PHAR1 - prefix: P87R2H - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Str	ACD	Start		M
Settings				
HaRst	ING	Number of harmonic restained		R
PhStr	ASG	Start Value		R
PhStop	ING	Stop Value		O
OpDlTmms	ING	Operate Delay Time		R
RsDlTmms	ING	Reset Delay Time		O

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of this protection stage

Common Logical Node Information→ OpCntRs: to count and store the number of operations of this stage

Status Information→ Str: for reporting the blocking signal 87R2H

Settings→ **HaRst**: for setting the harmonic (the 2nd) that activate the restraint of the OC stages (if equipped with Bl2ndHEna set to value = 1)

Settings→ **PhStr**: for setting the operating **threshold (%)** of the 2nd harmonic current

Settings→ **OpDlTmms**: for setting the blocking time **T_ini_2ndH** of the OC stages.

7.2.12 Automatic Load Shedding function (EAC)

The RGDM (ref. GSTP011) implements a set of functionalities and data models to perform the automatic load shedding of the relevant section of MV feeder. The following LNs model:

a. The general settings of the EAC function

b. The Blocking protection stages of the RGDM frequencies protections due to

- Undervoltage (27),
- Overvoltage (59),
- Maximum voltage unbalance β,
- Maximum frequency difference γ,
- Maximum allowed variation between consecutive periods Maxdt (salto di fase),
- Reverse Active Overpower,
- Conditioning of the frequency protection block;

c. Two tripping protections, all of which with

- Two independent frequency stages (settable as under/over-frequency),
- One rate of change of frequency (df/dt) stage.

Table 48 - type:GAPC7 - prefix: EACMng - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Controls				
SPCSO	SPC	Single point controllable status output		O
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
Auto	SPS	Automatic operation		O
Str	ACD	Start		M
Op	ACT	Operate	T	M
Settings				
StrVal1	ASG	Start Value (1)		R
StrVal2	ASG	Start Value (2)		R
StrVal3	ASG	Start Value (3)		R
StrVal4	ASG	Start Value (4)		R
StrVal5	ASG	Start Value (5)		R
StrVal6	ASG	Start Value (6)		R
StrVal7	ASG	Start Value (7)		R
StrVal8	ASG	Start Value (8)		R
StrVal9	ASG	Start Value (9)		R
StrVal10	ASG	Start Value (10)		R
StrVal11	ASG	Start Value (11)		R

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of events occurred (settings)

Settings→ StrVal1: for setting the number of semi-periods for the calculation of the average of the frequencies (1..32; step 1; default 10)

Settings→ StrVal2: for setting the number of semi-periods for the calculation of the df/dt first scale (0..20; step 1; default 15)

Settings→ StrVal3: for setting the number of semi-periods for the calculation of the df/dt second scale (0..20; step 1; default 10)

Settings→ StrVal4: for setting the number of semi-periods for the calculation of the df/dt third scale (0..20; step 1; default 5)

Settings→ StrVal5: for setting the number of averages for the calculation of the df/dt first scale (enumerative Averages 1, 2, 4, 8; default 8)

Settings→ StrVal6: for setting the number of averages for the calculation of the df/dt second scale (enumerative Averages 1, 2, 4, 8; default 4)

Settings→ StrVal7: for setting the number of averages for the calculation of the df/dt third scale (enumerative Averages 1, 2, 4, 8; default 2)

Settings→ StrVal8: for setting the enabling delay of the frequency protections (0..20 s; step 0.01 s; default 0.05 s)

Settings→ StrVal9: for setting the enabling delay of the df/dt protections from L1 (0..20 s; step 0.01 s; default 0.05 s)

Settings→ StrVal10: for setting the enabling delay of the df/dt protections from L2 (0..20 s; step 0.01 s; default 0.05 s)

Settings→ StrVal11: for setting the enabling delay of the df/dt protections from L3 (0..20 s; step 0.01 s; default 0.05 s).

7.2.12.1 Under/Over-voltage blocking stages

This function, able to block the operation of the frequency protections of the IED, consists of:

a. One Overvoltage stage,

b. One Undervoltage stage.

Table 49 – type:REBV1 - prefix: bUOV - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Controls				
IBPrUV	SPC	Inclusion of protection-blocking function due to Under Voltage		R
IBPrOV	SPC	Inclusion of protection-blocking function due to Ovder Voltage		R
Status Information				
StrBUV	ACD	Start due to Under Voltage		O
StrBOV	ACD	Start due to Over Voltage		O
OpBUV	ACT	Block to the Protection(s) due to Under Voltage	T	R
OpBOV	ACT	Block to the Protection(s) due to Over Voltage	T	R
Settings				
StrValUV	ASG	Start Value		R
StrValOV	ASG	Start Value Over Voltage		R
OpDlTmsUV	ASG	Operate Delay Time due to Over Voltage		R
OpDlTmsOV	ASG	Operate Delay Time due to Over Voltage		R
OpPTmsUV	ASG	Operate Persistency Time due to Under Voltage		R
OpPTmsOV	ASG	Operate Persistency Time due to Overer Voltage		R

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of blocking operations of this stage

Controls→ IBPrUV: for Enabling/Disabling the Undervoltage blocking function:

a. **0** = **UV Disabled**

b. **1** = **UV Enabled**

Controls→ IBPrOV: for Enabling/Disabling the Overvoltage blocking function:

c. **0** = **OV Disabled**

d. **1** = **OV Enabled**

Status Information→ OpBUV: for notifying the blocking of the frequency protections due to the Undervoltage blocking function

Status Information→ OpBOV: for notifying the blocking of the frequency protections due to the Overvoltage blocking function

Settings→ StrValUV: for setting the voltage threshold of the Undervoltage blocking stage (0 ÷ 1.4 Vn; step 0,05 Vn)

Settings→ StrValOV: for setting the voltage threshold of the Overvoltage blocking stage (0 ÷ 1.4 Vn; step 0,05 Vn)

Settings→ OpDlTmsUV: for setting the operate delay time of the Undervoltage blocking stage in seconds (0.1 ÷ 60 s, step 0,05 s)

Settings→ OpDlTmsOV: for setting the operate delay time of the Overvoltage blocking stage in seconds (0.1 ÷ 60 s, step 0,05 s)

Settings→ OpPTmsUV: for setting the blocking duration time due to the operation of the Undervoltage blocking stage in seconds (0.1 ÷ 1000 s, step 0,05 s)

Settings→ OpPTmsOV: for setting the blocking duration time due to the operation of the Overvoltage blocking stage in seconds (0.1 ÷ 1000 s, step 0,05 s).

7.2.12.2 Maximum voltage unbalance blocking stage

This function, able to block the operation of the frequency protections of the IED, consists of one Maximum voltage unbalance stage, operating when the Beta ratio (ref. GSTP011) supersedes a programmed threshold value.

Table 50 – type:GAPC8 - prefix: bMSq - LNInstance: 1

Attribute Name	Attribute Type	Explanation	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Controls				
SPCSO	SPC	Single point controllable status output		O
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
Auto	SPS	Automatic operation		O
Str	ACD	Start		M
Op	ACT	Operate	T	M
Settings				
StrVal1	ASG	Start Value (1)		R
StrVal2	ASG	Start Value (2)		R

StrVal3	ASG	Start Value (3)		R

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of this protection (default: Disabled)

Common Logical Node Information→ OpCntRs: to count and store the number of blocking operations of this stage

Status Information→ Op: for notifying the blocking of the frequency protections due to the Max. V unbalance blocking function

Settings→ StrVal1: for setting the **Beta** value of this stage (0,05 ÷ 1, step 0,05)

Settings→ StrVal2: for setting the reset delay time of this stage in seconds (0.1 ÷ 60 s, step 0,05 s)

Settings→ StrVal3: for setting the operate delay time of this stage in seconds (0.05 ÷ 1000 s, step 0,01 s).

7.2.12.3 Maximum frequency difference blocking stage

This function, able to block the operation of the frequency protections of the IED, consists of one Maximum frequency difference stage, operating when the Gamma ratio (ref. GSTP011) supersedes a programmed threshold value.

Table 51 – type:GAPC8 - prefix: bMdf - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Controls				
SPCSO	SPC	Single point controllable status output		O
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
Auto	SPS	Automatic operation		O
Str	ACD	Start		M
Op	ACT	Operate	T	M
Settings				
StrVal1	ASG	Start Value (1)		R
StrVal2	ASG	Start Value (2)		R
StrVal3	ASG	Start Value (3)		R

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of this protection (default: Disabled)

Common Logical Node Information→ OpCntRs: to count and store the number of blocking operations of this stage

Status Information→ Op: for notifying the blocking of the frequency protections due to the Max. frequency difference function

Settings→ StrVal1: for setting the **Gamma** value of this stage (10 ÷ 100 mHz, step 1 mHz)

Settings→ StrVal2: for setting the reset delay time of this stage in seconds (0 ÷ 100 s, step 0,01 s)

Settings→ StrVal3: for setting the operate delay time of this stage in seconds (0.05 ÷ 1000 s, step 0,01 s).

7.2.12.4 Maxdt (Maximum allowed variation between consecutive periods) blocking stage

This function, able to block the operation of the frequency protections of the IED, consists of one stage, operating due to discontinuous frequency variations (ref. GSTP011).

Table 52 – type:GAPC9 - prefix: bMdt - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Controls				
SPCSO	SPC	Single point controllable status output		O
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
Auto	SPS	Automatic operation		O
Str	ACD	Start		M
Op	ACT	Operate	T	M
Settings				
StrVal	ASG	Start Value (1)		R

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of this protection (default: Disabled)

Common Logical Node Information→ OpCntRs: to count and store the number of blocking operations of this stage

Status Information→ Op: for notifying the blocking of the frequency protections due to the Maxdt function

Settings→ StrVal: for setting the Maximum allowed variation between consecutive periods ΔT (50..7000μs, step 1μs; default 10μs) for the measurements of f and df/dt.

7.2.12.5 Reverse Active Overpower blocking stage

This function, able to block the operation of the frequency protections of the IED, consists of one stage (ref. GSTP011).

Table 53 – type:GAPC8 - prefix: bMPr - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Controls				
SPCSO	SPC	Single point controllable status output		O
DPCSO	DPC	Double point controllable status output		O

ISCSO	INC	Integer status controllable status output		O
Status Information				
Auto	SPS	Automatic operation		O
Str	ACD	Start		M
Op	ACT	Operate	T	M
Settings				
StrVal1	ASG	Start Value (1)		R
StrVal2	ASG	Start Value (2)		R
StrVal3	ASG	Start Value (3)		R

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of this protection (default: Disabled)

Common Logical Node Information→ OpCntRs: to count and store the number of blocking operations of this stage

Status Information→ Op: for notifying the blocking of the frequency protections due to the **Reverse** Active Overpower function

Settings→ StrVal1: for setting the P threshold value **StrValMV** of this stage (-1 ÷ 0 p.u.; step 0,01 p.u.; default -0.1 p.u.)

Settings→ StrVal2: for setting the reset delay time **OpDlTmsR** of this stage in seconds (0 ÷ 100 s, step 0,01 s)

Settings→ StrVal3: for setting the operate delay time **OpPTms** of this stage in seconds (0.05 ÷ 1000 s, step 0,01 s).

7.2.12.6 Conditioning of the Block to the frequency-based protection instances of the RGDM

This LN is used to connect the “operate” outputs of the above specified blocking stages to a common “operate” that will block the two frequency based protection instances (B1 and B2) of the RGDM.

Table 54 – type:PTRC2 - prefix: bGen - LNInstance: 1

Attribute Name	Attribute Type	Explanation	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Tr	ACT	Trip		(C) O
Op	ACT	Operate (combination of subscribed Op from protection functions)		(C) R
Str	ACD	Sum of all starts of all connected Logical Nodes		O
Settings				
TrMod	ING	Trip Mode		O
TrPlsTmms	ING	Trip Pulse Time		O

Condition C: At least one of the two status information (Tr, Op) shall be used.

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of blockings to the frequency-based protections of the EAC

Status Information→ Op: for notifying the block of the two frequency based protection instances (B1 and B2) of the RGDM due to one or more blocking stage.

7.2.12.7 Frequency and Rate of change of frequency based protection

The RGDM implements two instances (B1 and B2) of this composite protection; each instance consists of:

a. Two independent frequency stages (settable as under/over-frequency);

b. One rate of change of frequency (df/dt) stage;

c. Ad-hoc settings of the stages (ranges, timers, logic types,…);

d. Conditioning of the frequency-based stage operation.

Table 55 – type:PEFD1 - prefix: B1fdf - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Controls				
IProtF1	SPC	Inclusion of frequency protection (1)		R
IProtF2	SPC	Inclusion of frequency protection (2)		R
IProtdF	SPC	Inclusion of df/dt protection		R
Status Information				
Str	ACD	Start		M
Op	ACT	Operate	T	M
Settings				
IWsCh	SPG	Inclusion of active power sign check		R
SFPThy1	SPG	Selection of Frequency protection type (1)		R
SFPThy2	SPG	Selection of Frequency protection type (2)		R
SdFPThy	ING	Selection of df/dt protection type (2)		R
StrValF1	ASG	Start Value of frequency protection (1)		R
StrValF2	ASG	Start Value of frequency protection (2)		R
StrValdF	ASG	Start Value of df/dt protection		R
OpDlTmsF1	ASG	Operate Delay Time of frequency protection (1)		R
OpDlTmsF2	ASG	Operate Delay Time of frequency protection (2)		R
OpDlTmsdF	ASG	Operate Delay Time of df/dt protection		R

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of the whole B1 protection instance (default: Disabled)

Common Logical Node Information→ OpCntRs: to count and store the number of operations of this stage

Controls→ IProtF1: for Enabling/Disabling the f1 stage of the B1 protection instance:

a. **0 = f1 Disabled**

b. **1 = f1 Enabled**

Controls→ IProtF2: for Enabling/Disabling the f2 stage of the B1 protection instance:

c. **0 = f2 Disabled**

d. **1 = f2 Enabled**

Controls→ IProtdF: for Enabling/Disabling the df/dt stage of the B1 protection instance:

e. **0 = df Disabled**

f. **1** = **df Enabled**

Status Information→ Str: for notifying the Start signal of the B1 protection instance

Status Information→ Op: for notifying the Operate signal of the B1 protection instance

Settings → IWsCh: for Enabling/Disabling the P sign check of the B1 protection instance:

g. 0 = Off

h. **1** = On

Controls→ SFPThy1: for selecting the protection type of the f1 stage of the B1 protection instance:

i. 0 = Underfrequency f1

j. **1** = Overfrequency f1

Controls→ SFPThy2: for selecting the protection type of the f2 stage of the B1 protection instance:

k. 0 = Underfrequency f2

l. **1 = Overfrequency f2**

Controls→ SdFPThy: for selecting the protection type of the df/dt stage of the B1 **protection** instance:

m. 1 = Magnitude

n. **2** = Positive

o. **3** = Negative

Settings → StrValF1: for setting the **f1** threshold value of the B1 protection instance (45.00 ÷ 55.00 Hz; step 0,01 Hz)

Settings → StrValF2: for setting the **f2** threshold value of the B1 protection instance (45.00 ÷ 55.00 Hz; step 0,01 Hz)

Settings → StrValdF: for setting the **df/dt** threshold value of the B1 protection instance (0.1 ÷ 10 Hz/s; step 0,1 Hz/s)

Settings → OpDlTmsF1: for setting the **f1** operate delay time of the B1 protection instance in seconds (0 ÷ 60 s, step 0,01 s)

Settings → OpDlTmsF2: for setting the **f2** operate delay time of the B1 protection instance in seconds (0 ÷ 60 s, step 0,01 s)

Settings → OpDlTmsdF: for setting the **df/dt** operate delay time of the B1 protection instance in seconds (0 ÷ 60 s, step 0,01 s).

Table 56 – type:PEFD1 - prefix: B2fdf - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Controls				
IProtF1	SPC	Inclusion of frequency protection (1)		R
IProtF2	SPC	Inclusion of frequency protection (2)		R
IProtdF	SPC	Inclusion of df/dt protection		R
Status Information				
Str	ACD	Start		M

Op	ACT	Operate	T	M
Settings				
IWsCh	SPG	Inclusion of active power sign check		R
SFPThy1	SPG	Selection of Frequency protection type (1)		R
SFPThy2	SPG	Selection of Frequency protection type (2)		R
SdFPThy	ING	Selection of df/dt protection type (2)		R
StrValF1	ASG	Start Value of frequency protection (1)		R
StrValF2	ASG	Start Value of frequency protection (2)		R
StrValfdF	ASG	Start Value of df/dt protection		R
OpDlTmsF1	ASG	Operate Delay Time of frequency protection (1)		R
OpDlTmsF2	ASG	Operate Delay Time of frequency protection (2)		R
OpDlTmsdF	ASG	Operate Delay Time of df/dt protection		R

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of the whole B2 protection instance (default: Disabled)

Common Logical Node Information→ OpCntRs: to count and store the number of operations of this stage

Controls→ IProtF1: for Enabling/Disabling the f1 stage of the B2 protection instance:

a. **0** = **f1 Disabled**

b. **1** = **f1 Enabled**

Controls→ IProtF2: for Enabling/Disabling the f2 stage of the B2 protection instance:

c. **0** = **f2 Disabled**

d. **1** = **f3 Enabled**

Controls→ IProtdF: for Enabling/Disabling the df/dt stage of the B2 protection instance:

e. **0** = **df Disabled**

f. **1** = **df Enabled**

Status Information→ Str: for notifying the Start signal of the B2 protection instance

Status Information→ Op: for notifying the Operate signal of the B2 protection instance

Settings → IWsCh: for Enabling/Disabling the P sign check of the B2 protection instance:

g. 0 = Off

h. **1** = On

Controls→ SFPThy1: for selecting the protection type of the f1 stage of the B2 protection instance:

i. 0 = Underfrequency f1

j. **1** = Overfrequency f1

Controls→ SFPThy2: for selecting the protection type of the f2 stage of the B2 protection instance:

k. 0 = Underfrequency f2

l. **1** = Overfrequency f2

Controls→ SdFPThy: for selecting the protection type of the df/dt stage of the B2 protection instance:

m. 1 = Magnitude

n. **2** = Positive

o. **3** = Negative

Settings → StrValF1: for setting the **f1** threshold value of the B2 protection instance (45.00 ÷ 55.00 Hz; step 0,01 Hz)

Settings → StrValF2: for setting the **f2** threshold value of the B2 protection instance (45.00 ÷ 55.00 Hz; step 0,01 Hz)

Settings → StrValdF: for setting the **df/dt** threshold value of the B2 protection instance (0.1 ÷ 10 Hz/s; step 0,1 Hz/s)

Settings → OpDlTmsF1: for setting the **f1** operate delay time of the B2 protection instance in seconds (0 ÷ 60 s, step 0,01 s)

Settings → OpDlTmsF2: for setting the **f2** operate delay time of the B2 protection instance in seconds (0 ÷ 60 s, step 0,01 s)

Settings → OpDlTmsdF: for setting the **df/dt** operate delay time of the B2 protection instance in seconds (0 ÷ 60 s, step 0,01 s).

7.2.13 Broken Conductor Protection Function (I2/I1)

This function consists of a single stage.

Table 57 – type:GAPC6 - prefix: BC - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Controls				
SPCSO	SPC	Single point controllable status output		O
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
Auto	SPS	Automatic operation		O
Str	ACD	Start		M
Op	ACT	Operate	T	M
Settings				
StrVal1	ASG	Start Value (1)		R
StrVal2	ASG	Start Value (2)		R

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of operations of this stage

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of this protection stage

Status Information→ Str: for issuing the Start signal of this stage (mandatory)

Status Information→ Op: for issuing the Tripping signal of this stage (mandatory)

Settings → StrVal1: for setting the (I1/I2) threshold value of the Broken Conductor function (0,1..1,0.01,0.5 p.u.)

Settings → StrVal2: for setting the operate delay time of the Broken Conductor function (0.04..15000,0.01,1 sec).

7.2.14 Breaker Failure Protection related Function

This function consists of a single stage.

Table 58 – type:REBF1 - prefix: BF50 - LNInstance: 1

Attribute Name	Attribute Type	Explanation	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Str	ACD	Start		M
OpIn	ACT	Operate, retrip (“internal trip”)	T	R
Settings				
TPTrTms	ASG	Three Pole Retrip Time Delay (seconds)		R
ValAPEna	SPG	Enabling BF Activation for Phase Current Threshold		R
StrValAP	ASG	Phase Current Threshold Value		R
ValAREna	SPG	Enabling BF Activation for Residual Current Threshold		R
StrValAR	ASG	Residual Current Threshold Value		R
StrCBSig	SPG	BF Activation based on CB Signals		R
Pe46S1	SPG	Protection Stage enabling the BF - 46S1		O
Pe46S4	SPG	Protection Stage enabling the BF - 46S4		O
PeN46S1	SPG	Protection Stage enabling the BF - N46S1		O
PeA51S1	SPG	Protection Stage enabling the BF - 51S1		O
Pe51S2	SPG	Protection Stage enabling the BF - 51S2		O
Pe51S3	SPG	Protection Stage enabling the BF - 51S3		O
Pe51S4	SPG	Protection Stage enabling the BF - 51S4		O
PeN51S1	SPG	Protection Stage enabling the BF - N51S1		R
PeN51S2	SPG	Protection Stage enabling the BF - N51S2		R
PeN51S3	SPG	Protection Stage enabling the BF - N51S3		R
PeN51S1a	SPG	Protection Stage enabling the BF - N51S1a		O
PeN51S2a	SPG	Protection Stage enabling the BF - N51S2a		O
PeN51SE	SPG	Protection Stage enabling the BF - N51SE		O
PeN51S1	SPG	Protection Stage enabling the BF - N51RS1		O
PeN51RS2	SPG	Protection Stage enabling the BF - N51RS2		O
PeN51RS3	SPG	Protection Stage enabling the BF - N51RS3		O
Pe67S1	SPG	Protection Stage enabling the BF - 67S1		O
Pe67S2	SPG	Protection Stage enabling the BF - 67S2		O
Pe67S3	SPG	Protection Stage enabling the BF - 67S3		O
Pe67S4	SPG	Protection Stage enabling the BF - 67S4		O
PeN67S1	SPG	Protection Stage enabling the BF - N67S1		R
PeN67S2	SPG	Protection Stage enabling the BF - N67S2		R
PeN67S2a	SPG	Protection Stage enabling the BF - N672a		O
PeN67S2b	SPG	Protection Stage enabling the BF - N672b		O
PeN67S3	SPG	Protection Stage enabling the BF - N673		R
PeN67S4	SPG	Protection Stage enabling the BF - N674		R
PeN67b	SPG	Protection Stage enabling the BF - N67b		O
PeOCS1	SPG	Protection Stage enabling the BF - OCS1		R
PeOCS2	SPG	Protection Stage enabling the BF - OCS2		R

PeOCS3	SPG	Protection Stage enabling the BF - OCS3		R
PeOCS4	SPG	Protection Stage enabling the BF - OCS4		R
Pe59NS1	SPG	Protection Stage enabling the BF - 59NS1		R
Pe59NS2	SPG	Protection Stage enabling the BF - 59NS2		R
Pe59V21	SPG	Protection Stage enabling the BF - 59V21		R
Pe32PS1	SPG	Protection Stage enabling the BF - 32PS1		R
PeBC	SPG	Protection Stage enabling the BF - Broken Conductor		R
PeEDIn	SPG	Protection Stage enabling the BF - External Digital Input		R

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of this function

Common Logical Node Information→ OpCntRs: to count and store the number of operations of this function

Status Information→ Str: for issuing the Start signal of the 50BF

Status Information→ OpIn: for issuing the Tripping signal of the 50BF

Settings→ TPTrTms: for setting the operate delay time of the stage **T50BF** (0.06..10; 0.01 sec; 1s)

Settings→ ValAPEna: for Enabling/Disabling the BF function activation due to the Phase Current Threshold:

a. 0 = Phase Current Threshold Disabled

b. **1** = Phase Current Threshold Enabled (Default)

Settings→ StrValAP: for setting the Phase Current Threshold of this stage (0.05..1; 0.01; 0.1 p.u.)

Settings→ ValAREna: for Enabling/Disabling the BF function activation due to the Residual Current Threshold:

c. 0 = Residual Current Threshold Disabled

d. **1 = Residual Current Threshold Enabled (Default)**

Settings→ StrValAR: for setting the Residual Current Threshold of this stage (0.01..2; 0.01; 0.1 p.u.)

Settings→ StrCBSig: for setting the BF function activation based on Signals from the Circuit Breaker:

e. 0 = CB Signals Triggering Disabled

f. **1** = CB Signals Triggering Enabled (Default)

Settings→ PeN51S1: for Enabling/Disabling the BF function activation due to the Operations of the Protection Stage OC.S1:

g. 0 = N51.S1 Op Triggering Disabled (Default)

h. **1** = N51.S1 Op Triggering Enabled

Settings→ PeEDIn: for Enabling/Disabling the BF function activation due to the status of the external Digital Input:

i. 0 = Digital IN Status Triggering Disabled (Default)

j. **1** = Digital IN Status Triggering Enabled.

7.2.15 Conditioning of the RGDM protections operations affecting the Circuit Breaker status

This LN is used to connect the “operate” outputs of one or more protections stages to a common “operate” that will trip the MV Circuit Breaker.

Table 59 – type:PTRC1 - prefix: P_Sum - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Status Information				
Tr	ACT	Trip		(C) O
Op	ACT	Operate (combination of subscribed Op from protection functions)		(C) R
Str	ACD	Sum of all starts of all connected Logical Nodes		R
Settings				
TrMod	ING	Trip Mode		O
TrPlsTmms	ING	Trip Pulse Time		O

Condition C: At least one of the two status information (Tr, Op) shall be used.

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of operations of the RGDM protections due to a fault detection

Status Information→ Op: for notifying the trip to the Circuit Breaker triggered by one or more protection stages

Status Information→ Str: for notifying the start triggered by one or more protection stages.

7.3 Logical Device Recloser: details of the LN

The LD Recloser (LD_Rec) includes all the Logical Nodes which data is used in the communication supporting the Automatic Reclosing function. This function performs the reclosing procedure of the MV Circuit Breaker after it has been opened due to a fault.

The behaviour of this function (reclosing sequences) depends on the type of Protection that operated (ref. GSTP011). Therefore, tailored settings per single protection stage shall be modelled.

LLN01 type				
Attribute Name	**Attribute Type**	**Explanation**	**T**	**M/O**
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation for complete logical device		O
OpTmh	INS	Operation Time		O
Controls				
Diag	SPC	Run Diagnostic		O
LEDRs	SPC	LED reset	T	O

type:LPHD2 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	**T**	**M/O**
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
PhyNam	DPL	Physical device name plate		M
PhyHealth	INS	Physical device health		M
OutOv	SPS	Output communications buffer overflow		O

Proxy	SPS	Indicates if this LN is a proxy		M
InOv	SPS	Input communications buffer overflow		O
NumPwrUp	INS	Number of Power ups		O
WrmStr	INS	Number of Warm Starts		O
WacTrg	INS	Number of watchdog device resets detected		O
PwrUp	SPS	Power Up detected		O
PwrDn	SPS	Power Down detected		O
PwrSupAlm	SPS	External power supply alarm		O
RsStat	SPC	Reset device statistics	T	O

7.3.1 Auto-Reclosing function management

The following LN is dedicated to the recloser notifications and settings, including its enabling/disabling.

Table 60 – type:RREC1 - prefix: R79Mng - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
OpCntRs	INC	Resetable operation counter		R
Controls				
BlkRec	SPC	Block Reclosing		R
ChkRec	SPC	Check Reclosing		O
Status Information				
Auto	SPS	Automatic Operation (external switch status)		R
Op	ACT	Operate (used here to provide close to XCBR)	T	M
AutoRecSt	INS	Auto Reclosing Status		M
Settings				
Rec1Tmms	ING	First Reclose Time		O
Rec2Tmms	ING	Second Reclose Time		O
Rec3Tmms	ING	Third Reclose Time		O
PlsTmms	ING	Close Pulse Time		O
RclTmms	ING	Reclaim Time		O

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of the automatic reclosing function (default: Disabled)

Common Logical Node Information→ OpCntRs: to count and store the number of events occurred

Controls → BlkRec: for the remote setting of the reclosing function block (volatile info, not retained in long-term memory storage in the absence of power supply):

k. 0 = Recloser unblocked (R)

l. 1 = Recloser blocked (E)

Status Information → Auto: for notifying the state of the automatic reclosing function. It is the logic AND among an external command (as per IEC 61850) from the RTU, the position of the dedicated selector on the front panel of the IED and the settings via configuration SW:

m. 0 = De-activated

n. 1 = Active

Status Information → Op: for notifying the **79X** signal, that means that closing command has been issued to the Circuit Breaker

Status Information → AutoRecSt: for notifying **79X_CRC** signal, that means that the reclosing sequence is in progress (=2).

7.3.2 Additional automatic reclosing function settings

The following LN includes typical settings of the automatic reclosing function in the RGDM, in particular its operation according to the type of protection that opened the Circuit Breaker.

Table 61 – type:GGIO6 - prefix: R79TsP - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO1	SPC	Single point controllable status output (1)		R
SPCSO2	SPC	Single point controllable status output (2)		R
SPCSO3	SPC	Single point controllable status output (3)		R
SPCSO4	SPC	Single point controllable status output (4)		R
SPCSO5	SPC	Single point controllable status output (5)		R
SPCSO6	SPC	Single point controllable status output (6)		R
SPCSO7	SPC	Single point controllable status output (7)		R
SPCSO8	SPC	Single point controllable status output (8)		R
SPCSO9	SPC	Single point controllable status output (9)		R
SPCSO10	SPC	Single point controllable status output (10)		R
SPCSO11	SPC	Single point controllable status output (11)		R
SPCSO12	SPC	Single point controllable status output (12)		R
SPCSO13	SPC	Single point controllable status output (13)		R
SPCSO14	SPC	Single point controllable status output (14)		R
DPCSO	DPC	Double point controllable status output		O
ISCSO1	INC	Integer status controllable status output (1)		R
ISCSO2	INC	Integer status controllable status output (2)		R
ISCSO3	INC	Integer status controllable status output (3)		R
ISCSO4	INC	Integer status controllable status output (4)		R
ISCSO5	INC	Integer status controllable status output (5)		R
ISCSO6	INC	Integer status controllable status output (6)		R
ISCSO7	INC	Integer status controllable status output (7)		R
ISCSO8	INC	Integer status controllable status output (8)		R
ISCSO9	INC	Integer status controllable status output (9)		R
ISCSO10	INC	Integer status controllable status output (10)		R
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		O
Ind	SPS	General indication (binary input)		O

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of events occurred (configurations)

Controls → SPCSO1: for selecting the reclosing sequence:

a. 0 = **RR**

b. 1 = **RR** + **RL** (Default)

Controls → SPCSO2: for setting the acceleration of the Protection stages (if with dual time calibration) in case of disabled 79 (1 = acceleration)

Controls → SPCSO3: for setting the Enabling/Disabling of the TD in case of manual closing:

c. 0 = Disabled

d. 1 = Enabled

Controls → SPCSO4: for setting the Enabling/Disabling of the 79 in case of OC.S1 operation:

e. 0 = Disabled

f. 1 = Enabled (Default)

Controls → SPCSO5: for setting the Enabling/Disabling of the 79 in case of OC.S2 operation:

g. 0 = Disabled

h. 1 = Enabled (Default)

Controls → SPCSO6: for setting the Enabling/Disabling of the 79 in case of OC.S3 operation:

i. 0 = Disabled

j. 1 = Enabled (Default)

Controls → SPCSO7: for setting the Enabling/Disabling of the 79 in case of OC.S4 operation

k. 0 = Disabled

l. 1 = Enabled (Default)

Controls → SPCSO8: for setting the Enabling/Disabling of the 79 in case of 51N.S1 operation:

m. 0 = Disabled (Default)

n. 1 = Enabled

Controls → SPCSO9: for setting the Enabling/Disabling of the 79 in case of 51N.S2 operation:

o. 0 = Disabled (Default)

p. 1 = Enabled

Controls → SPCSO10: for setting the Enabling/Disabling of the 79 in case of 51N.S3 operation:

q. 0 = Disabled (Default)

r. 1 = Enabled

Controls → SPCSO11: for setting the Enabling/Disabling of the 79 in case of 67N.S1 operation:

s. 0 = Disabled

t. 1 = Enabled (Default)

Controls → SPCSO12: for setting the Enabling/Disabling of the 79 in case of 67N.S2 operation:

u. 0 = Disabled

v. 1 = Enabled (Default)

Controls → SPCSO13: for setting the Enabling/Disabling of the 79 in case of 67N.S3 operation:

w. 0 = Disabled

x. 1 = Enabled (Default)

Controls → SPCSO14: for setting the Enabling/Disabling of the 79 in case of 67N.S4 operation:

y. 0 = Disabled

z. 1 = Enabled (Default)

Controls → ISCSO1: for setting the **RM** - number of "Memorized Closings" (0..5; 1; 3)

Controls → ISCSO2: for setting the **TRR** - interruption/isolation Time of the RR (100..1000ms; 10ms; default 600ms)

Controls → ISCSO3: for setting the **TRL** - interruption/isolation Time of the RL (1..200s; 1s; default 30s)

Controls → ISCSO4: for setting the **TNf** - Neutralization Timer in case of phase fault trip (1..200s; 1s; default 70s)

Controls → ISCSO5: for setting the **TNt** - Neutralization Timer in case of earth fault trip (1..200s; 1s; default 70s)

Controls → ISCSO6: for setting the **TDrr** - Discrimination Timer for the RR (0..10s; 1s; default 5s)

Controls → ISCSO7: for setting the **TDrl** - Discrimination Timer for the RL (0..10s; 1s; 5s)

Controls → ISCSO8: for setting the **TDrm** - Discrimination Timer for the RM (0..10s; 1s; 5s)

Controls → ISCSO9: for setting the **TDi** - Discrimination Timer for the manual closing (1..10s; 1s; 5s)

Controls → ISCSO10: for setting the **TMrp** - Max. reset time of the protections (0.. 10min; 50ms; 0.5s).

7.3.3 Failed Reclosing alarm (FR)

Table 62 – type:CALH1 - prefix: R79FR - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Status Information				
GrAlm	SPS	Group alarm		M
GrWrn	SPS	Group warning		O
AllmLstOv	SPS	Alarm list overflow		O

NOTES:

Status Information→ GrAlm: for notifying the **FR** - Failed Reclosing alarm.

7.4 Logical Device Medium voltage Feeder Automation: details of the Logical Nodes

The LD MV Feeder Automation (LD_MFA) includes all the Logical Nodes which data are used to communicate with the RGDMs installed in the same MV feeder in order to support the Logic selectivity (based on the BLIND messages) and Remote Disconnection functions.

The information exchanged with the Distributed Generation are modelled in a dedicated Logical Device (LD_DRM) although related to automation functions too.

LLN01 type				
Attribute Name	**Attribute Type**	**Explanation**	**T**	**M/O**
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				

		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation for complete logical device		O
OpTmh	INS	Operation Time		O
Controls				
Diag	SPC	Run Diagnostic		O
LEDRs	SPC	LED reset	T	O

type:LPHD2 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	**T**	**M/O**
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
PhyNam	DPL	Physical device name plate		M
PhyHealth	INS	Physical device health		M
OutOv	SPS	Output communications buffer overflow		O
Proxy	SPS	Indicates if this LN is a proxy		M
InOv	SPS	Input communications buffer overflow		O
NumPwrUp	INS	Number of Power ups		O
WrmStr	INS	Number of Warm Starts		O
WacTrg	INS	Number of watchdog device resets detected		O
PwrUp	SPS	Power Up detected		O
PwrDn	SPS	Power Down detected		O
PwrSupAlm	SPS	External power supply alarm		O
RsStat	SPC	Reset device statistics	T	O

7.4.1 Absence/Presence of the Voltage

The RGDM issues to the DS RTU/Client the notification related to the Voltage Absence/Presence measured on the:

a. MV bus-bar (RVS signal);

b. MV feeder (RVL signal).

Table 63 – type:GGIO5 - prefix: RVL_S - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO	SPC	Single point controllable status output		O
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
IntIn	INS	Integer status input		O
Alm1	SPS	General single alarm (1)		R
Alm2	SPS	General single alarm (2)		R

Ind	SPS	General indication (binary input)		O

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of events occurred

Controls → SPCSO: for mapping the Absence/Presence of the voltage (RVS signal) on the MV busbar from the UP2020 Lite:

a. 0 = Absence

b. 1 = Presence

Status Information → Alm1: for notifying the Absence/Presence of the voltage (RVL signal) on the MV feeder:

c. 0 = Absence

d. 1 = Presence

Status Information → Alm2: for notifying the Absence/Presence of the voltage (RVS signal) on the MV busbar:

e. 0 = Absence

f. 1 = Presence.

7.4.2 Management of the automatic selection of a faulty trunk (STG)

Typical settings and automations management for the faulty trunk automatic selection

Table 64 – type:GGIO8 - prefix: STGMng - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO1	SPC	Single point controllable status output (1)		R
SPCSO2	SPC	Single point controllable status output (2)		R
SPCSO3	SPC	Single point controllable status output (3)		R
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		R
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		O
Ind	SPS	General indication (binary input)		O

NOTES:

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of the STG automation

Common Logical Node Information→ OpCntRs: to count and store the number of events occurred

Controls → SPCSO1: for mapping the **REVERSAL** signal received by the UP2020 Lite, for the reversal of the OC.S1..S4 (when directional) and 67N.S1..S3 tripping sectors:

a. **0 = forward direction**

b. **1 = reverse direction**

Controls → SPCSO2: for enabling the permission to the closing operation (back-feeding) issued by the DMS via the MV/LV DS UP, to get the control of the back-feeding circuit breaker:

c. **0 = Permission Denied**

d. **1 = Permission Enabled** (boundary RGDM)

Controls → SPCSO3: for enabling the Remote Trip Logic, adopted when the upstream (basing on the TAG) RGDM manages the fault on the MV feeder:

e. **0 = Remote Trip Disabled**

f. **1 = Remote Trip Enabled**

Controls → ISCSO: for setting the logic type:

g. **0 = FRT**

h. **1 = FSL**

i. **2 = DBR**

j. **3 = SFS**

k. **4 = DSR**.

7.4.3 RGDM Topological Address (TAG)

The following LN models the TAG (topological address, consisting of twelve integers) of the RGDM, used to identify the role (predecessor/successor) of the IEDs that participate in the Logic Selectivity (FSL) and Remote Disconnection (TDLP) by comparing its own TAG with those received from the other IEDs in the same MV feeder.

Only the stVal of the $Taddr_n$ is sent to optimize the message size and the resulting network traffic.

Table 65 – type:AETA1 - prefix: TAG - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Controls				
TAddr1	INC	Topological Address (1)		R
TAddr2	INC	Topological Address (2)		R
TAddr3	INC	Topological Address (3)		R
TAddr4	INC	Topological Address (4)		R
TAddr5	INC	Topological Address (5)		R
TAddr6	INC	Topological Address (6)		R
TAddr7	INC	Topological Address (7)		R
TAddr8	INC	Topological Address (8)		R
TAddr9	INC	Topological Address (9)		R
TAddr10	INC	Topological Address (10)		R

TAddr11	INC	Topological Address (11)		R
TAddr12	INC	Topological Address (12)		R
AdrLevBN	INC	Address Level - Bit Number of the TAG		R

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of configurations

Controls → TAddr1: for setting the IED's **TAG_1** (used/meaningful if >0)

Controls → TAddr2: for setting the IED's **TAG_2** (used/meaningful if >0)

Controls → TAddr3: for setting the IED's **TAG_3** (used/meaningful if >0)

Controls → TAddr4: for setting the IED's **TAG_4** (used/meaningful if >0)

Controls → TAddr5: for setting the IED's **TAG_5** (used/meaningful if >0)

Controls → TAddr6: for setting the IED's **TAG_6** (used/meaningful if >0)

Controls → TAddr7: for setting the IED's **TAG_7** (used/meaningful if >0)

Controls → TAddr8: for setting the IED's **TAG_8** (used/meaningful if >0)

Controls → TAddr9: for setting the IED's **TAG_9** (used/meaningful if >0)

Controls → TAdrr10: for setting the IED's **TAG_10** (used/meaningful if >0)

Controls → TAddr11: for setting the IED's **TAG_11** (used/meaningful if >0)

Controls → TAddr12: for setting the IED's **TAG_12** (used/meaningful if >0)

Controls → AdrLevBN: for setting the length (number of bits) of each addressing level of the TAG_n DO.

The TAG is contained both in BLIND + Remote Close + Remote Trip GOOSEs (7.4.4) and in the Remote Disconnection (TDLP) messages (7.4.6).

7.4.4 Logic Selectivity Function (FSL)

The Data Model and the communication for the FSL (used to select and isolate the Faulty MV line trunk) consist of:

a. Configuration/management of typical data (timers, GOOSE payload type, function reset, etc.) and publishing of its own BLIND to the electrically upstream RGDMs;

b. Management and Monitoring/Subscription of the BLIND from the electrically downstream RGDMs.

7.4.4.1 FSL Management - BLIND to the upstream RGDM

Table 66 – type:GGIO9_C - prefix: FSLMng - LNInstance: 1				
Attribute Name	Attribute Type	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO	SPC	Single point controllable status output		R
DPCSO	DPC	Double point controllable status output		O

ISCSO1	INC	Integer status controllable status output (1)		R
ISCSO2	INC	Integer status controllable status output (2)		R
ISCSO3	INC	Integer status controllable status output (3)		R
ISCSO4	INC	Integer status controllable status output (4)		R
ISCSO5	INC	Integer status controllable status output (5)		R
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		O
Ind	SPS	General indication (binary input)		O

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of events occurred

Controls → SPCSO: for issuing the BLIND signal to the upstreanm RGDMs

a. **0 = no BLIND** (protections operation permitted)

b. **1 = BLIND** (protections operation inhibited)

Controls → ISCSO1: for setting the timer **Tatt,** maximum waiting time of the BLIND signal (if the RGDM is connected to the network), published by the downstream RGDMs, before its own protections trip the Circuit Breaker (0..500ms; 1ms)

Controls → ISCSO2: for setting the timer **Tr** (0..500ms; 1ms)

Controls → ISCSO3: for setting the timer **Tadd** (0..100ms; 1ms)

Controls → ISCSO4 for setting the timer $\mathbf{T_{RG}fake}$ (0..500ms; 1ms)

Controls → ISCSO5: for setting the timer $\mathbf{T_{RGD}}$ (0..500ms; 1ms).

This LN of the LD_MFA publishes the BLIND via GOOSE (including its own address TAG_n, as defined in Par. 7.4.3) to the upstream RGDMs as a consequence of a fault detection.

7.4.4.2 FSL – BLIND monitoring

The following LN type is instantiated thirty times (only two instances are documented for the sake of conciseness) in order to map the BLIND (GOOSE) messages coming from maximum of thirty electrically downstream RGDMs.

Table 67 – type:GGIO9_M - prefix: FSLMon -LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO	SPC	Single point controllable status output		R
DPCSO	DPC	Double point controllable status output		O
ISCSO1	INC	Integer status controllable status output (1)		R
ISCSO2	INC	Integer status controllable status output (2)		R
ISCSO3	INC	Integer status controllable status output (3)		R

ISCSO4	INC	Integer status controllable status output (4)		R
ISCSO5	INC	Integer status controllable status output (5)		R
ISCSO6	INC	Integer status controllable status output (6)		R
ISCSO7	INC	Integer status controllable status output (7)		R
ISCSO8	INC	Integer status controllable status output (8)		R
ISCSO9	INC	Integer status controllable status output (9)		R
ISCSO10	INC	Integer status controllable status output (10)		R
ISCSO11	INC	Integer status controllable status output (11)		R
ISCSO12	INC	Integer status controllable status output (12)		R
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		O
Ind	SPS	General indication (binary input)		O

LNInstance: 2..29 - prefix: FSLMon

Same LN type.

Table 68 - type:GGIO9_M - prefix: FSLMon - LNInstance: 30				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO	SPC	Single point controllable status output		R
DPCSO	DPC	Double point controllable status output		O
ISCSO1	INC	Integer status controllable status output (1)		R
ISCSO2	INC	Integer status controllable status output (2)		R
ISCSO3	INC	Integer status controllable status output (3)		R
ISCSO4	INC	Integer status controllable status output (4)		R
ISCSO5	INC	Integer status controllable status output (5)		R
ISCSO6	INC	Integer status controllable status output (6)		R
ISCSO7	INC	Integer status controllable status output (7)		R
ISCSO8	INC	Integer status controllable status output (8)		R
ISCSO9	INC	Integer status controllable status output (9)		R
ISCSO10	INC	Integer status controllable status output (10)		R
ISCSO11	INC	Integer status controllable status output (11)		R
ISCSO12	INC	Integer status controllable status output (12)		R
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		O
Ind	SPS	General indication (binary input)		O

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of events occurred

Controls → SPCSO: for mapping the **BLIND** signal from the downstream RGDM

a. **0 = no BLIND** (internal protections operation permitted)

b. **1 = BLIND** (internal protections operation inhibited)

Controls → ISCSO1: for mapping the **TAG_1** of the electrically downstream RGDMs (used/meaningful if >0)

Controls → ISCSO2: for mapping the **TAG_2** of the electrically downstream RGDMs (used/meaningful if >0)

Controls → ISCSO3: for mapping the **TAG_3** of the electrically downstream RGDMs (used/meaningful if >0)

Controls → ISCSO4: for mapping the **TAG_4** of the electrically downstream RGDMs (used/meaningful if >0)

Controls → ISCSO5: for mapping the **TAG_5** of the electrically downstream RGDMs (used/meaningful if >0)

Controls → ISCSO6: for mapping the **TAG_6** of the electrically downstream RGDMs (used/meaningful if >0)

Controls → ISCSO7: for mapping the **TAG_7** of the electrically downstream RGDMs (used/meaningful if >0)

Controls → ISCSO8: for mapping the **TAG_8** of the electrically downstream RGDMs (used/meaningful if >0)

Controls → ISCSO9: for mapping the **TAG_9** of the electrically downstream RGDMs (used/meaningful if >0)

Controls→ISCSO10: for mapping the **TAG_10** of the electrically downstream RGDMs (used/meaningful if >0)

Controls→ISCSO11: for mapping the **TAG_11** of the electrically downstream RGDMs (used/meaningful if >0)

Controls→ISCSO12: for mapping the **TAG_12** of the electrically downstream RGDMs (used/meaningful if >0).

This LN of the LD_MFA is ready to receive, via GOOSE messages, the “BLIND” (including the address TAG_n, as defined in Par. 7.4.3) issued by one or more electrically downstream RGDM and used to avoid that the RGDM trips the controlled Circuit Breaker in case of a fault that has to be isolated in a different trunk of the feeder.

7.4.5 SFS and DSR

The LN dedicated to the SFS and DSR management models the:

a. Remote Trip for opening the Circuit Breaker controlled by the RGDM located at the other side of the faulty section (SFS);

b. Remote Close for back-feeding the MV feeder (SFS if required by the RGDM, DSR if required by the UP2020 Lite).

7.4.5.1 SFS and DSR (Remote Trip and Close)

Table 69 – type:GGIO11 - prefix: SFSDSR - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O

EEName	DPL	External equipment name plate			O
Loc	SPS	Local operation			O
OpCntRs	INC	Resetable operation counter			R
Measured values					
AnIn	MV	Analogue input			O
Controls					
SPCSO1	SPC	Single point controllable status output (1)			R
SPCSO2	SPC	Single point controllable status output (2)			R
SPCSO3	SPC	Single point controllable status output (3)			R
SPCSO4	SPC	Single point controllable status output (4)			R
DPCSO	DPC	Double point controllable status output			O
ISCSO	INC	Integer status controllable status output			O
Status Information					
IntIn	INS	Integer status input			O
Alm	SPS	General single alarm			O
Ind	SPS	General indication (binary input)			O

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of events occurred

Controls → SPCSO1: for issuing the "Remote Trip Command" to the electrically downstream RGDM (SFS) at the other side of the faulty trunk:

a. **0 = no Remote Trip**

b. **1 = Remote Trip** (opening of the Circuit Breaker at the other side of the faulty trunk)

Controls → SPCSO2: for mapping the "Remote Trip Command" issued by the electrically upstream RGDM (SFS), to open the controlled Circuit Breaker and to report it to the Client:

c. **0 = no Remote Trip**

d. **1 = Remote Trip** (remote opening of the controlled Circuit Breaker)

Controls → SPCSO3: for issuing the "Remote Close Command" to the RGDM which controls the back-feeding Circuit Breaker (SFS):

e. **0 = no Remote Close**

f. **1 = Remote Close** (closing of the back-feeding Circuit Breaker)

Controls → SPCSO4: for mapping the "Remote Close Command" from the RGDM that is managing the fault (SFS) or from the UP2020 Lite (DSR), in order to achieve the back-feeding and to report it to the Client:

g. **0 = no Remote Close**

h. **1 = Remote Close** (closing of the back-feeding Circuit Breaker to back-feeding).

This LN issues, including its own TAG_n, the "Remote Trip Command" to the electrically downstream RGDM and the "Remote Close Command" to the RGDM handling the back-feeding via GOOSE (the same used for the BLIND), after the detection and the management of a fault.

This LN is also ready to receive, via GOOSE, the "Remote Trip Command" and the "Remote Close Command" according to the role during the fault management phase.

7.4.6 Remote Disconnection Function (TDLP)

The Data Model and communication for the Remote Disconnection Function (TDLP) is divided into two parts:

a. **Configuration** of typical data (Enabling/Disabling, Remote Disconnection),

b. **Management** and Monitoring of the Remote Disconnection Command from the HV/MV DS and/or from the electrically upstream RGDMs.

The RGDM implements three different Remote Disconnection modes:

c. when one (or more) protection inside the RGDM or MFP at the head of the same MV feeder trips the controlled Circuit Breaker on the MV feeder, the IED publishes the "Remote Disconnection" GOOSE, including its own TAG, to all the downstream RGDM. As a consequence, each downstream RGDM publishes the "Open PI" GOOSE towards possible IDC_Prot;

d. the Client in the Substation (UP2020 Lite, when available), via MMS, controls the Remote Disconnection trigger in the RGDM that propagates it via GOOSE towards all the downstream RGDM;

e. the Primary Substation RTU, via GOOSE with an ad-hoc TAG (its own address or simulating the identity of a downstream IED), propagates the Remote Disconnection towards all the downstream RGDM.

7.4.6.1 Remote Disconnection management

Table 70 – type:GGIO10_C - prefix: TDMng - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO	SPC	Single point controllable status output		R
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		O
Ind	SPS	General indication (binary input)		O

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of events occurred

Common Logical Node Information→ Mod: for handling the **Enabling/Disabling** command (1/5) of the (TDLP) Remote Disconnection function (default: Disabled)

Controls→ SPCSO: for issuing the Remote Disconnection Command TDLP (internally triggered or requested by the UP2020 Lite) to the downstream RGDM**:**

a. **0 = No TDLP**

b. **1** = **TDLP**.

This LN is ready to issue via GOOSE the TDLP command to the downstream RGDM including its own TAG_n (as defined in 7.4.3). The underlying function, therefore, issues the tripping command to the possible IDC_Prot as specified in 7.5.3 and 7.5.5.

7.4.6.2 TDLP monitoring

The following LN type is instantiated thirty one times (only two instances are documented for the sake of brevity) in order to map the TDLP Commands (GOOSE messages) coming from maximum of thirty one electrically upstream IED (the first instance is allocated to the Primary Substation RTU in the HV/MV DS, the second instance to the MFP at the head of the MV feeder and the following instances to the electrically upstream RGDM).

Table 71 – type:GGIO10_M - prefix: TDMon - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO	SPC	Single point controllable status output		R
DPCSO	DPC	Double point controllable status output		O
ISCSO1	INC	Integer status controllable status output (1)		R
ISCSO2	INC	Integer status controllable status output (2)		R
ISCSO3	INC	Integer status controllable status output (3)		R
ISCSO4	INC	Integer status controllable status output (4)		R
ISCSO5	INC	Integer status controllable status output (5)		R
ISCSO6	INC	Integer status controllable status output (6)		R
ISCSO7	INC	Integer status controllable status output (7)		R
ISCSO8	INC	Integer status controllable status output (8)		R
ISCSO9	INC	Integer status controllable status output (9)		R
ISCSO10	INC	Integer status controllable status output (10)		R
ISCSO11	INC	Integer status controllable status output (11)		R
ISCSO12	INC	Integer status controllable status output (12)		R
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		O
Ind	SPS	General indication (binary input)		O

LNInstance: 2..30 - prefix: TDMon

Same LN type.

Table 72 - type:GGIO10_M - prefix: TDMon - LNInstance: 31				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O

Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO	SPC	Single point controllable status output		R
DPCSO	DPC	Double point controllable status output		O
ISCSO1	INC	Integer status controllable status output (1)		R
ISCSO2	INC	Integer status controllable status output (2)		R
ISCSO3	INC	Integer status controllable status output (3)		R
ISCSO4	INC	Integer status controllable status output (4)		R
ISCSO5	INC	Integer status controllable status output (5)		R
ISCSO6	INC	Integer status controllable status output (6)		R
ISCSO7	INC	Integer status controllable status output (7)		R
ISCSO8	INC	Integer status controllable status output (8)		R
ISCSO9	INC	Integer status controllable status output (9)		R
ISCSO10	INC	Integer status controllable status output (10)		R
ISCSO11	INC	Integer status controllable status output (11)		R
ISCSO12	INC	Integer status controllable status output (12)		R
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		O
Ind	SPS	General indication (binary input)		O

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of events occurred

Controls → SPCSO: for mapping the **TDLP** signal from the UP / Primary Substation RTU and/or upstream IED (MFP/RGDM)

a. **0 = No TDLP (no commands towards the controlled possible IDC_Prot);**

b. **1 = TDLP (commands towards the controlled possible IDC_Prot).**

Controls → ISCSO1: for mapping the **TAG_1** of the electrically upstream IEDs (used/meaningful if >0)

Controls → ISCSO2: for mapping the **TAG_2** of the electrically upstream IEDs (used/meaningful if >0)

Controls → ISCSO3: for mapping the **TAG_3** of the electrically upstream IEDs (used/meaningful if >0)

Controls → ISCSO4: for mapping the **TAG_4** of the electrically upstream IEDs (used/meaningful if >0)

Controls → ISCSO5: for mapping the **TAG_5** of the electrically upstream IEDs (used/meaningful if >0)

Controls → ISCSO6: for mapping the **TAG_6** of the electrically upstream IEDs (used/meaningful if >0)

Controls → ISCSO7: for mapping the **TAG_7** of the electrically upstream IEDs (used/meaningful if >0)

Controls → ISCSO8: for mapping the **TAG_8** of the electrically upstream IEDs (used/meaningful if >0)

Controls → ISCSO9: for mapping the **TAG_9** of the electrically upstream IEDs (used/meaningful if >0)

Controls→ISCSO10: for mapping the **TAG_10** of the electrically upstream IEDs (used/meaningful if >0)

Controls→ISCSO11: for mapping the **TAG_11** of the electrically upstream IEDs (used/meaningful if >0)

Controls→ISCSO12: for mapping the **TAG_12** of the electrically upstream IEDs (used/meaningful if >0).

This LN is ready to receive, via GOOSE messages, the “Remote Disconnection Command” including the address TAG_n (as defined in Par. 7.4.3) issued by the electrically upstream IEDs (from the HV/MV Distribution Substation and RGDMs) and used by the RGDM to publishes the “Open IP” GOOSE towards the controlled possible IDC_Prot (ref. 7.5.3).

7.5 Distributed energy Resources Management Logical Device: Detail of the Logical Nodes

The Distributed energy Resources Management Logical Device (LD_DRM) includes all the Logical Nodes which data are used for the communication between the MV/LV DS and the DER plant (including the PI, PG and possible IDC_DERs) to manage the generation and the voltage regulation along the MV feeder.

The DRM includes the UPG function as well as the communication intermediation function, for legacy, between the DS Client and the IEDs (according to GSTP011) in the DER plant.

LLN01 type				
Attribute Name	**Attribute Type**	**Explanation**	**T**	**M/O**
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation for complete logical device		O
OpTmh	INS	Operation Time		O
Controls				
Diag	SPC	Run Diagnostic		O
LEDRs	SPC	LED reset	T	O

LNInstance: 1 LPHD2 type				
Attribute Name	**Attribute Type**	**Explanation**	**T**	**M/O**
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
PhyNam	DPL	Physical device name plate		M
PhyHealth	INS	Physical device health		M
OutOv	SPS	Output communications buffer overflow		O
Proxy	SPS	Indicates if this LN is a proxy		M
InOv	SPS	Input communications buffer overflow		O
NumPwrUp	INS	Number of Power ups		O
WrmStr	INS	Number of Warm Starts		O
WacTrg	INS	Number of watchdog device resets detected		O
PwrUp	SPS	Power Up detected		O
PwrDn	SPS	Power Down detected		O
PwrSupAlm	SPS	External power supply alarm		O
RsStat	SPC	Reset device statistics	T	O

7.5.1 UPG Management

The following LN models the:

a. UPG Enabling/Disabling and Configuration of UPG typical data (locally used on RGDM);

b. Notifications to the Client according to the UPG logics execution (VFLS and VFLI).

Table 73 – type:GAPC2 - prefix: UPGMng - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	**T**	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				

		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Controls				
SPCSO1	SPC	Single point controllable status output (1)		R
SPCSO2	SPC	Single point controllable status output (2)		R
DPCSO	DPC	Double point controllable status output		O
ISCSO1	INC	Integer status controllable status output (1)		R
ISCSO2	INC	Integer status controllable status output (2)		R
ISCSO3	INC	Integer status controllable status output (3)		R
ISCSO4	INC	Integer status controllable status output (4)		R
ISCSO5	INC	Integer status controllable status output (5)		R
ISCSO6	INC	Integer status controllable status output (6)		R
ISCSO7	INC	Integer status controllable status output (7)		R
ISCSO8	INC	Integer status controllable status output (8)		R
ISCSO9	INC	Integer status controllable status output (9)		R
Status Information				
Auto	SPS	Automatic operation		O
Str	ACD	Start		M
Op	ACT	Operate	T	M
Settings				
StrVal1	ASG	Start Value(1)		R
StrVal2	ASG	Start Value(2)		R
StrVal3	ASG	Start Value(3)		R
StrVal4	ASG	Start Value(4)		R
StrVal5	ASG	Start Value(5)		R
StrVal6	ASG	Start Value(6)		R
StrVal7	ASG	Start Value(7)		R
StrVal8	ASG	Start Value(8)		R
StrVal9	ASG	Start Value(9)		R
StrVal10	ASG	Start Value(10)		R
StrVal11	ASG	Start Value(11)		R
StrVal12	ASG	Start Value(12)		R

NOTES:

Common Logical Node Information→ Mod: for handling the Enabling/Disabling command (1/5) of UPG

Common Logical Node Information→ OpCntRs: to count and store the number of events (alarms/settings) occurred

Controls → SPCSO1: for issuing the **VFLS** signal

a. **0 = VFLS off**

b. **1 = VFLS on**

Controls → SPCSO2: for issuing the **VFLI** signal

c. **0 = VFLI off**

d. **1 = VFLI on**

Controls → ISCSO1: for setting the T_{RVL} (min)

Settings → StrVal1: for setting the $V_{1S\text{-}UPG}$ (p.u.: 0.90..1.20; 0.01)

Controls → ISCSO2: for setting the timer $T_{1S\text{-}UPG}$ (sec. 0…1000; 1s)

Settings → StrVal2: for setting the $V_{2S\text{-}UPG}$ (p.u.: 0.90..1.20; 0.01)

Controls → ISCSO3: for setting the timer $T_{2S\text{-}UPG}$ (sec. 0…1000; 1s)

Settings → StrVal3: for setting the $V_{1S\text{-}VCS}$ (p.u.: 0.90..1.20; 0.01)

Controls → ISCSO4: for setting the timer $T_{1S\text{-}VCS}$ (sec. 0…1000; 1s)

Settings → StrVal4: for setting the $V_{2S\text{-}VCS}$ (p.u.: 0.90..1.20; 0.01)

Controls → ISCSO5: for setting the timer $T_{2S\text{-}VCS}$ (sec. 0…1000; 1s)

Settings → StrVal5: for setting the $V_{1I\text{-}UPG}$ (p.u.: 0.90..1.20; 0.01)

Controls → ISCSO6: for setting the timer $T_{1I\text{-}UPG}$ (sec. 0…1000; 1s)

Settings → StrVal6: for setting the $V_{2I\text{-}UPG}$ (p.u.: 0.90..1.20; 0.01)

Controls → ISCSO7: for setting the timer $T_{2I\text{-}UPG}$ (sec. 0…1000; 1s)

Settings → StrVal7: for setting the $V_{1I\text{-}VSC}$ (p.u.: 0.90..1.20; 0.01)

Controls → ISCSO8: for setting the timer $T_{1I\text{-}VCS}$ (sec. 0…1000; 1s)

Settings → StrVal8: for setting the $V_{2I\text{-}VSC}$ (p.u.: 0.90..1.20; 0.01)

Controls → ISCSO9: for setting the timer $T_{2I\text{-}VCS}$ (sec. 0…1000; 1s)

Settings → StrVal9: for setting the cosfi in P generation mode - inductive case (-1..0; 0.01)

Settings → StrVal10: for setting the cosfi in P absorption mode - inductive case (-1..0; 0.01)

Settings → StrVal11: for setting the cosfi in P generation mode - capacitive case (0..1; 0.01)

Settings → StrVal12: for setting the cosfi in P absorption mode - capacitive case (0..1; 0.01).

7.5.2 Commands and/or settings towards possible IDC_DERs

The following LN models the:

a. Enabling/Disabling command and Set point values applied to possible IDC_DER:
   - If UPGon=1 (UPG is enabled), locally defined by the UPG function (only for cosfi) or
   - if UPGon=0 (UPG is disabled), received from the Client (for Rcosfi, RQ ed RP);

b. Enabling/disabling requests of the RQV and RPFP functions.

Table 74 – type:GGIO16 - prefix: CCI_Do - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn1	MV	Analogue input (1)		R
AnIn2	MV	Analogue input (2)		R
AnIn3	MV	Analogue input (3)		R
AnIn4	MV	Analogue input (4)		R
AnIn5	MV	Analogue input (5)		R
Controls				
SPCSO	SPC	Single point controllable status output		O

DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		O
Ind1	SPS	General indication (binary input) (1)		R
Ind2	SPS	General indication (binary input) (2)		R
Ind3	SPS	General indication (binary input) (3)		R
Ind4	SPS	General indication (binary input) (4)		R
Ind5	SPS	General indication (binary input) (5)		R

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of events (settings) occurred

Settings → AnIn1: for setting the cosfi in P generation mode, inductive case (-1..0; 0.01) and capacitive case (0..1; 0.01)

Settings → AnIn2: for setting the cosfi in P absorption mode, inductive case (-1..0; 0.01) and capacitive case (0..1; 0.01)

Controls → Ind1: for notifying (0=OFF; 1=ON) the application of the cosfi Set point to the possible IDC_DER (via GOOSE) and for reporting it to the Client

Settings → AnIn3: for setting the **RQ** - exchanged Q (signed float)

Controls → Ind2: for handling the application of $\mathbf{RQ_{act}}$ (0=OFF; 1=ON)

Settings → AnIn4: for setting the **RP** – maximum value of P in generation (signed float)

Settings → AnIn5: for setting the **RP** – maximum value of P in absorption (signed float)

Controls → Ind3: for handling the application of $\mathbf{RP_{act}}$ (0=OFF; 1=ON)

Controls → Ind4: for setting the **RQV** due to the request (from the Center/Client towards the possible IDC_DER) of activation of the Reactive Power regulation as a function of the voltage (1 = Enabled ; 0 = Disabled)

Controls → Ind5: for setting the **RPFP** due to the request (from the Center/Client towards the possible IDC_DER) of activation of the Power Factor regulation as a function of the Active Power (1 = Enabled; 0 = Disabled).

This LN issues to possible IDC_DER, via GOOSE messages, all the above specified settings (both received from the Client and calculated by the internal logics).

The following LN is modelled in order to map the commands and settings received from the Client and forwarded to the possible IDC_DER when the UPG function is disabled (UPG_{on}=0).

Table 75 – type:GAPC3 - prefix: CCI_Di - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Controls				
SPCSO1	SPC	Single point controllable status output (1)		R
SPCSO2	SPC	Single point controllable status output (2)		R
SPCSO3	SPC	Single point controllable status output (3)		R

SPCSO4	SPC	Single point controllable status output (4)		R
SPCSO5	SPC	Single point controllable status output (5)		R
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
Auto	SPS	Automatic operation		O
Str	ACD	Start		M
Op	ACT	Operate	T	M
Settings				
StrVal1	ASG	Start Value(1)		R
StrVal2	ASG	Start Value(2)		R
StrVal3	ASG	Start Value(3)		R
StrVal4	ASG	Start Value(4)		R
StrVal5	ASG	Start Value(5)		R

NOTE:

Common Logical Node Information→ OpCntRs: to count and store the number of events (settings) occurred

Settings → StrVal1: for setting the cosfi in P generation mode, inductive case (-1..0; 0.01) and capacitive case (0..1; 0.01)

Settings → StrVal2: for setting the cosfi in P absorption mode, inductive case (-1..0; 0.01) **and** capacitive case (0..1; 0.01)

Controls → SPCSO1: for handling the $\mathbf{R_{cosfiact}}$, application of the cosfi Set point imposed by the Client on the possible IDC_DER (1 = apply; 0 = do not apply)

Settings → StrVal3: for mapping the **RQ** - exchanged Q imposed by the Client on the possible IDC_DER (signed float)

Controls → SPCSO2: for handling the $\mathbf{RQ_{act}}$, application of the **RQ** value imposed by the Client on the possible IDC_DER (1 = apply; 0 = do not apply)

Settings → StrVal4: for mapping the **RP** – maximum value of P in generation imposed by the Client on the possible IDC_DER (signed float)

Settings → StrVal5: for mapping the **RP** – maximum value of P in absorption imposed by the Client on the possible IDC_DER (signed float)

Controls → SPCSO3: for handling the $\mathbf{RP_{act}}$, application of the **RP** value imposed by the Client on the possible IDC_DER (1 = apply; 0 = do not apply)

Controls → SPCSO4: for mapping the **RQV** (Reactive Power regulation as a function of the voltage) activation request from the Client (1 = Enabled; 0 = Disabled)

Controls → SPCSO5: for mapping the **RPFP** (power factory regulation as a function of the active power) activation request from the Client (1 = Enabled; 0 = Disabled).

7.5.3 Remote commands towards IP and GP

The following LN models the remote commands received from the Client and forwarded to the IP and the GP (through possible IDC_Prot in the DER plant). The acknowledge of the command execution from the PI and PG consists of the position change of the handled circuit breakers, as specified in 7.5.4.

Table 76 – type:GGIO11_C - prefix: TCPIPG - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		

Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO1	SPC	Single point controllable status output (1)		R
SPCSO2	SPC	Single point controllable status output (2)		R
SPCSO3	SPC	Single point controllable status output (3)		R
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		O
Ind	SPS	General indication (binary input)		O

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of events occurred

Controls → SPCSO1: for mapping the Generation Disconnection Remote command (IP):

a. **0 = ID closing Enabled**

b. **1 = Remote Disconnection / ID closing Disabled**

Controls → SPCSO2: for mapping the Plant Disconnection command (GP) from the Client:

c. **0 = GD closing Enabled**

d. **1 = Plant Disconnection / GD closing Disabled**

Controls → SPCSO3: for selecting the P81 thresholds setting; this command is issued after a request from Client or due to an interruption of the communication on the WAN:

e. **0 = P81 narrow thresholds**

f. **1 = P81 extended thresholds.**

This LN is used to issue, via GOOSE, to possible IDC_Prot the following commands received from the Client:

g. Remote Disconnection of the generation (IP) after a fault/command;

h. Remote Disconnection of the Plant (GP);

i. P81 thresholds set selection.

7.5.4 Notifications from IP and GP

The following LN is used to map, through the possible IDC_Prot, the position of the IP and GP circuit breakers, the P81 threshold set currently used and the Start of the GP (for the locking of the RGDM protections trip according to GSTP011). These notifications are forwarded to the Client.

Table 77 – type:GGIO11_N - prefix: NPIPG - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				

Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO1	SPC	Single point controllable status output (1)		R
SPCSO2	SPC	Single point controllable status output (2)		R
SPCSO3	SPC	Single point controllable status output (3)		R
SPCSO4	SPC	Single point controllable status output (4)		R
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		O
Ind	SPS	General indication (binary input)		O

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of events occurred

Controls → SPCSO1: for mapping the IP circuit breaker position (ID):

a. **0 = Opened**

b. **1 = Closed**

Controls → SPCSO2: for mapping the GP circuit breaker position (GD):

c. **0 = Opened**

d. **1 = Closed**

Controls → SPCSO3: for mapping the currently used P81 thresholds set:

e. **0 = P81 narrow thresholds**

f. **1 = P81 extended thresholds**

Controls → SPCSO4: for subscribing the GP Start signal and (potentially) lock the MV/LV DS circuit breaker trip (FSL). This is equivalent to a BLIND signal from a downstream RGDM:

g. **1 = GP start in progress**

h. **0 = Other GP state.**

This LN is ready to receive, via GOOSE inputs, the following information from other IEDs (possible IDC_Prot):

i. IP Circuit Breaker position;

j. GP Circuit Breaker position;

k. P81 threshold set;

l. GP Start.

7.5.5 Load Reduction Remote Command and other commands to possible IDC_Prot

This LN is used to model the Customer's Load Reduction Remote Command (RCU), received from the Client and forwarded to the possible IDC_Prot. The LN can be used also to control the possible IDC_Prot's Spare Output.

Table 78 – type:GGIO12_C - prefix: TRCUSO - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO1	SPC	Single point controllable status output (1)		R
SPCSO2	SPC	Single point controllable status output (2)		R
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		O
Ind	SPS	General indication (binary input)		O

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of events occurred

Controls → SPCSO1: for mapping the Customer's Load Reduction Remote Command (RCU) from the Client:

a. **0 = Customer's Load Restoration**

b. **1 = Customer's Load Reduction**

Controls → SPCSO2: for mapping the Spare Output (SO) state change command to the possible IDC_Prot:

c. **0 = Open**

d. **1 = Close.**

This LN is used to issue, via GOOSE, to possible IDC_Prot the following commands received from the Client:

e. Customer's Load Reduction Remote Command (RCU);

f. SO Command.

7.5.6 Notifications related to the state of Spare Input, Spare Output and Customer's Load Reduction from possible IDC_Prot

This LN is used to map the notifications related to the state of possible IDC_Prot Spare Input, Spare Output and Customer's Load Reduction contacts. These notifications are forwarded to the Client.

Table 79 – type:GGIO12_N - prefix: NSIORC - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O

LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO1	SPC	Single point controllable status output (1)		R
SPCSO2	SPC	Single point controllable status output (2)		R
SPCSO3	SPC	Single point controllable status output (3)		R
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		O
Ind	SPS	General indication (binary input)		O

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of events occurred

Controls → SPCSO1: for mapping the state of possible IDC_Prot Spare Input contact:

a. **0 = Opened**

b. **1 = Closed**

Controls → SPCSO2: for mapping the state of possible IDC_Prot Spare Output contact:

c. **0 = Opened**

d. **1 = Closed**

Controls → SPCSO3: for mapping the state of possible IDC_Prot Customer's Load **Reduction** contact:

e. **0 = Load Restoration**

f. **1 = Load Reduction.**

This LN is ready to receive, via GOOSE inputs, the following information from other IEDs (possible IDC_Prot):

g. SI - Spare Input state;

h. SO - Spare Output state;

i. Customer's Load Reduction RCU state.

7.5.7 Alarms and notifications from possible IDC_DER

This LN is used to map the notifications and alarms categorized into General Info, Generation System, Controllable Load and Storage coming from the possible IDC_DER of a connected plant (DER + Loads + Storage). These notifications are forwarded to the Client.

Table 80 – type:GGIO13 - prefix: Ntfl_D - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		

Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO1	SPC	Single point controllable status output (1)		R
SPCSO2	SPC	Single point controllable status output (2)		R
SPCSO3	SPC	Single point controllable status output (3)		R
SPCSO4	SPC	Single point controllable status output (4)		R
SPCSO5	SPC	Single point controllable status output (5)		R
SPCSO6	SPC	Single point controllable status output (6)		R
SPCSO7	SPC	Single point controllable status output (7)		R
SPCSO8	SPC	Single point controllable status output (8)		R
SPCSO9	SPC	Single point controllable status output (9)		R
SPCSO10	SPC	Single point controllable status output (10)		R
SPCSO11	SPC	Single point controllable status output (11)		R
SPCSO12	SPC	Single point controllable status output (12)		R
SPCSO13	SPC	Single point controllable status output (13)		R
SPCSO14	SPC	Single point controllable status output (14)		R
SPCSO15	SPC	Single point controllable status output (15)		R
SPCSO16	SPC	Single point controllable status output (16)		R
SPCSO17	SPC	Single point controllable status output (17)		R
SPCSO18	SPC	Single point controllable status output (18)		R
SPCSO19	SPC	Single point controllable status output (19)		R
SPCSO20	SPC	Single point controllable status output (20)		R
SPCSO21	SPC	Single point controllable status output (21)		R
SPCSO22	SPC	Single point controllable status output (22)		R
SPCSO23	SPC	Single point controllable status output (23)		R
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		O
Ind	SPS	General indication (binary input)		O

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of events occurred

Controls → SPCSO1: for mapping the General Info (GI) - operational state of the plant:

a. **1 = Operational**

b. **0 = Out of Service**

Controls → SPCSO2: for mapping the GI - Maximum Active Power in generation of the plant:

c. **1 = Limit value reached**

d. **0 = Below the limit**

Controls → SPCSO3: for mapping the GI - Maximum Active Power in absorption mode of the plant:

e. **1 = Limit value reached**

f. **0 = Below the limit**

Controls → SPCSO4: for mapping the GI - Maximum Inductive Reactive Power of the plant:

g. **1 = Limit value reached**

h. **0 = Below the limit**

Controls → SPCSO5: for mapping the GI - Maximum Capacitive Reactive Power of the plant:

i. **1 = Limit value reached**

j. **0 = Below the limit**

Controls → SPCSO6: for mapping the GI - Insufficient Reactive Power:

k. **1 = Active**

l. **0 = Inactive**

Controls → SPCSO7: for mapping the Generation System (GS) - operational state of the generator:

m. **1 = generation of P**

n. **0 = No generation/Out of service**

Controls → SPCSO8: for mapping the GS - Limitations to the active power of the generator:

o. **1 = Active**

p. **0 = Inactive**

Controls → SPCSO9: for mapping the GS - Reactive Power exchange of the generator:

q. **1 = Active**

r. **0 = Inactive**

Controls → SPCSO10: for mapping the GS - Maximum Inductive Reactive Power of the generator:

s. **1 = Limit value reached**

t. **0 = Below the limit**

Controls → SPCSO11: for mapping the GS - Maximum Capacitive Reactive Power of the generator:

u. **1 = Limit value reached**

v. **0 = Below the limit**

Controls → SPCSO12: for mapping the Controllable Load (CL) - operational state of the customer's load modulation device:

w. **1 = Operational**

x. **0 = Out of Service**

Controls → SPCSO13: for mapping the CL - Limitations to the active power absorbed by the customer's load:

y. **1 = Lowered load**

z. **0 = Total load**

Controls → SPCSO14: for mapping the CL - Maximum reduction of the active power absorbed by the customer's load:

aa. **1 = Limit value reached**

bb. **0 = Below the limit**

Controls → SPCSO15: for mapping the Storage System (SS) - operational state of the storage:

cc. **1 = Operational**

dd. **0 = Out of Service**

Controls → SPCSO16: for mapping the SS - Reactive Power exchange of the storage:

ee. **1 = Storage operating with power factory different from 1**

ff. **0 = Storage operating with power factory equal to 1**

Controls → SPCSO17: for mapping the SS - Maximum Active Power in generation of the storage:

gg. **1 = Limit value reached**

hh. **0 = Below the limit**

Controls → SPCSO18: for mapping the SS - Maximum Active Power in absorption of the **Storage**:

ii. **1 = Limit value reached;**

jj. **0 = Below the limit.**

Controls → SPCSO19: for mapping the SS - Maximum Inductive Reactive Power of the **Storage**:

kk. **1 = Limit value reached;**

ll. **0 = Below the limit.**

Controls → SPCSO20: for mapping the SS - Maximum Capacitive Reactive Power of the Storage:

mm. **1 = Limit value reached;**

nn. **0 = Below the limit.**

Controls → SPCSO21: ready for any future use/development;

Controls → SPCSO22: ready for any future use/development;

Controls → SPCSO23: ready for any future use/development.

This LN is ready to receive the above specified information as inputs via GOOSE issued by the possible IDC_DER in order to forward the same information to the Client.

7.5.8 State and origin of the operating modes from possible IDC_DER

This LN is used to map the information related to the operating modes of the DER plant; in particular, for each mode, the state and the originator of the selection (Client via MMS, RGDM via GOOSE, or both) are specified.

Table 81 – type:GGIO15 - prefix: ModI_D - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO	SPC	Single point controllable status output		O
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
IntIn1	INS	Integer status input (1)		R

IntIn2	INS	Integer status input (2)		R
IntIn3	INS	Integer status input (3)		R
IntIn4	INS	Integer status input (4)		R
IntIn5	INS	Integer status input (5)		R
IntIn6	INS	Integer status input (6)		R
IntIn7	INS	Integer status input (7)		R
IntIn8	INS	Integer status input (8)		R
IntIn9	INS	Integer status input (9)		R
IntIn10	INS	Integer status input (10)		R
IntIn11	INS	Integer status input (11)		R
IntIn12	INS	Integer status input (12)		R
IntIn13	INS	Integer status input (13)		R
IntIn14	INS	Integer status input (14)		R
Alm	SPS	General single alarm		O
Ind	SPS	General indication (binary input)		O

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of events occurred

Status Information → IntIn1: for mapping the state of the “Active Power Limitation” operating mode of the DER plant

Status Information → IntIn2: for mapping the requester of the “Active Power Limitation” operating mode of the DER plant

Status Information → IntIn3: for mapping the state of the “Reactive Power Set point” operating mode of the DER plant

Status Information → IntIn4: for mapping the requester of the “Reactive Power Set point” operating mode of the DER plant

Status Information → IntIn5: for mapping the state of the “cosfi Set point” operating mode of the **DER** plant

Status Information → IntIn6: for mapping the requester of the “cosfi Set point” operating mode of the DER plant

Status Information → IntIn7: for mapping the state of the “Q(V) Regulation” operating mode of the DER plant

Status Information → IntIn8: for mapping the requester of the “Q(V) Regulation” operating mode **of** the DER plant

Status Information → IntIn9: for mapping the state of the “cosfi(P) Regulation” operating mode of the DER plant

Status Information → IntIn10: for mapping the requester of the “cosfi(P) Regulation” **operating** mode of the DER plant

Status Information → IntIn11: for mapping the state of the “P(f) Regulation” operating mode of the DER plant

Status Information → IntIn12: for mapping the requester of the “P(f) Regulation” operating mode of the DER plant

Status Information → IntIn13: for mapping the state of the “PTF Regulation" operating mode of the DER plant

Status Information → IntIn14: for mapping the requester of the “PTF Regulation" operating mode of the DER plant.

This LN is ready to receive the above specified information as inputs via GOOSE issued by the possible IDC_DER in order to forward the same information to the Client.

7.5.9 Measurement from IDC_DER with the customer to the Control Center

Due to the nature of the communication between UPG and possible IDC_DER, the measurements from possible IDC_DER with the customer are issued via GOOSE; the RGDM, accordingly, reports the same information to the Client with the proper granularity period.

7.5.9.1 Periodic instantaneous measurements (10 sec)

This LN is used to map the electrical quantities measured by the possible IDC_DER at the generator terminals and transmitted every 10 seconds. The following information are issued:

a. Supported Measurements (two 32 bit-masks, one bit for each measurement according to the order specified in GSTP011 and detailed below in the LN description);

b. Measurements values, their quality and timestamp (as issued by the possible IDC_DER.

Due to the high number of measurements modelled in the possible IDC_DER (already implemented or simply ready), the content of the LN is transmitted with two different reports in order to limit the data traffic; for this reason the report containing the measurements 33-64 will be issued only when at least one measurement in this set will be used. Therefore, the model includes one LN which data will be carried by two different Reports (with dedicated data-sets and control blocks), one containing the measurements 1-32 (and the related bitmask) and the other with the measurements 33-64 (and related bitmask).

Table 82 – type:GGIO14 - prefix: MiMI2C - LNInstance: 1

Attribute Name	Attribute Type	Explanation	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		O
Measured values				
AnIn1	MV	Analogue input (1)		R
AnIn2	MV	Analogue input (2)		R
AnIn3	MV	Analogue input (3)		R
AnIn4	MV	Analogue input (4)		R
AnIn5	MV	Analogue input (5)		R
AnIn6	MV	Analogue input (6)		R
AnIn7	MV	Analogue input (7)		R
AnIn8	MV	Analogue input (8)		R
AnIn9	MV	Analogue input (9)		R
AnIn10	MV	Analogue input (10)		R
AnIn11	MV	Analogue input (11)		R
AnIn12	MV	Analogue input (12)		R
AnIn13	MV	Analogue input (13)		R
AnIn14	MV	Analogue input (14)		R
AnIn15	MV	Analogue input (15)		R
AnIn16	MV	Analogue input (16)		R
AnIn17	MV	Analogue input (17)		R
AnIn18	MV	Analogue input (18)		R
AnIn19	MV	Analogue input (19)		R
AnIn20	MV	Analogue input (20)		R
AnIn21	MV	Analogue input (21)		R
AnIn22	MV	Analogue input (22)		R

AnIn23	MV	Analogue input (23)		R
AnIn24	MV	Analogue input (24)		R
AnIn25	MV	Analogue input (25)		R
AnIn26	MV	Analogue input (26)		R
AnIn27	MV	Analogue input (27)		R
AnIn28	MV	Analogue input (28)		R
AnIn29	MV	Analogue input (29)		R
AnIn30	MV	Analogue input (30)		R
AnIn31	MV	Analogue input (31)		R
AnIn32	MV	Analogue input (32)		R
AnIn33	MV	Analogue input (33)		R
AnIn34	MV	Analogue input (34)		R
AnIn35	MV	Analogue input (35)		R
AnIn36	MV	Analogue input (36)		R
AnIn37	MV	Analogue input (37)		R
AnIn38	MV	Analogue input (38)		R
AnIn39	MV	Analogue input (39)		R
AnIn40	MV	Analogue input (40)		R
AnIn41	MV	Analogue input (41)		R
AnIn42	MV	Analogue input (42)		R
AnIn43	MV	Analogue input (43)		R
AnIn44	MV	Analogue input (44)		R
AnIn45	MV	Analogue input (45)		R
AnIn46	MV	Analogue input (46)		R
AnIn47	MV	Analogue input (47)		R
AnIn48	MV	Analogue input (48)		R
AnIn49	MV	Analogue input (49)		R
AnIn50	MV	Analogue input (50)		R
AnIn51	MV	Analogue input (51)		R
AnIn52	MV	Analogue input (52)		R
AnIn53	MV	Analogue input (53)		R
AnIn54	MV	Analogue input (54)		R
AnIn55	MV	Analogue input (55)		R
AnIn56	MV	Analogue input (56)		R
AnIn57	MV	Analogue input (57)		R
AnIn58	MV	Analogue input (58)		R
AnIn59	MV	Analogue input (59)		R
AnIn60	MV	Analogue input (60)		R
AnIn61	MV	Analogue input (61)		R
AnIn62	MV	Analogue input (62)		R
AnIn63	MV	Analogue input (63)		R
AnIn64	MV	Analogue input (64)		R
Controls				
SPCSO	SPC	Single point controllable status output		O
DPCSO	DPC	Double point controllable status output		O
ISCSO1	INC	Integer status controllable status output (1)		R
ISCSO2	INC	Integer status controllable status output (2)		R
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		O
Ind	SPS	General indication (binary input)		O

NOTES:

Controls → ISCSO1: measurements [1…32] availability bitmask (according to the order specified in GSTP011)

Controls → ISCSO2: measurements [33…64] availability bitmask (according to the order specified in GSTP011) - reserved for future use/development

Measured Values → AnIn1: for mapping the measurement of the phase-to-phase Voltage V_{12-4} (RMS value in kV) at the generator terminals (single-pole or three-pole depending on the type of inverter) issued by possible IDC_DER

Measured Values → AnIn2: for mapping the measurement of the phase-to-phase Voltage V_{4-8} (RMS value in kV) at the generator terminals (single-pole or three-pole depending on the type of inverter) issued by possible IDC_DER

Measured Values → AnIn3: for mapping the measurement of the phase-to-phase Voltage V_{8-12} (RMS value in kV) at the generator terminals (single-pole or three-pole depending on the type of inverter) issued by possible IDC_DER

Measured Values → AnIn4: for mapping the measurement of the frequency (Hz) at the generator terminals, issued by possible IDC_DER

Measured Values → AnIn5: for mapping the measurement of P (kW) absorbed by the Load, issued by possible IDC_DER

Measured Values → AnIn6: for mapping the measurement of Q (kVAr) absorbed by the Load, issued by possible IDC_DER

Measured Values → AnIn7: for mapping the measurement of P (kW) absorbed by the Interruptible Load, issued by possible IDC_DER

Measured Values → AnIn8: for mapping the measurement of Q (kVAr) absorbed by the Interruptible Load, issued by possible IDC_DER

Measured Values → AnIn9: for mapping the measurement of P (kW) of the storage, issued by possible IDC_DER

Measured Values → AnIn10: for mapping the measurement of Q (kVAr) of the storage, issued by possible IDC_DER

Measured Values → AnIn11: for mapping the measurement of the actual storage capacity (% of the rated capacity), issued by possible IDC_DER

Measured Values → AnIn12: for mapping the measurement of the state of charge of the storage (% of the actual capacity), issued by possible IDC_DER

Measured Values → AnIn13: for mapping the measurement of the residual charge/discharge cycles (integer) of the storage, issued by possible IDC_DER

Measured Values → AnIn14: for mapping the measurement of P exchanged with the MV grid (kW), issued by possible IDC_DER

Measured Values → AnIn15: for mapping the measurement of Q exchanged with the MV grid (**kVAr**), issued by possible IDC_DER

Measured Values → AnIn16: reserved for future use/development

Measured Values → AnIn17: for mapping the measurement of the P (kW) generated by the **photovoltaic** generation system, issued by possible IDC_DER

Measured Values → AnIn18: for mapping the measurement of the Q (kVAr) generated by the **photovoltaic** generation system, issued by possible IDC_DER

Measured Values → AnIn19: for mapping the measurement of the P (kW) generated by the **wind** power generation system, issued by possible IDC_DER

Measured Values → AnIn20: for mapping the measurement of the Q (kVAr) generated by the **wind** power generation system, issued by possible IDC_DER

Measured Values → AnIn21: for mapping the measurement of the P (kW) generated by the **thermal** power generation system, issued by possible IDC_DER

Measured Values → AnIn22: for mapping the measurement of the Q (kVAr) generated by the thermal power generation system, issued by possible IDC_DER

Measured Values → AnIn23: for mapping the measurement of the P (kW) generated by the hydro power generation system, issued by possible IDC_DER

Measured Values → AnIn24: for mapping the measurement of the Q (kVAr) generated by the hydro power generation system, issued by possible IDC_DER

Measured Values → AnIn25: for mapping the measurement of the P (kW) generated by other sources of power generation, issued by possible IDC_DER

Measured Values → AnIn26: for mapping the measurement of the Q (kVAr) generated by other sources of power generation, issued by possible iIDC_DER

Measured Values → AnIn27: reserved for future use/development

Measured Values → AnIn28: reserved for future use/development

Measured Values → AnIn29: reserved for future use/development

Measured Values → AnIn30: reserved for future use/development

Measured Values → AnIn31: reserved for future use/development

Measured Values → AnIn32: reserved for future use/development

Measured Values → AnIn33…64: reserved for future use/development.

This LN is ready to receive the above specified information (bitmasks excluded as configured in the RGDM) as inputs via GOOSE issued by the possible IDC_DER.

7.5.9.2 Periodic average measurements (10 min)

This LN is used to map the electrical quantities measured by the possible IDC_DER at the generator terminals, averaged and transmitted every 10 minutes. The information content and the receiving/issuing modalities are the same as already defined for the instantaneous measurements; the only difference is the granularity period of the transmission that, in this case, is equal to 10 min.

Table 83 – type:GGIO14 - prefix: MmMI2C - LNInstance: 1

Attribute Name	Attribute Type	Explanation	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		O
Measured values				
AnIn1	MV	Analogue input (1)		R
AnIn2	MV	Analogue input (2)		R
AnIn3	MV	Analogue input (3)		R
AnIn4	MV	Analogue input (4)		R
AnIn5	MV	Analogue input (5)		R
AnIn6	MV	Analogue input (6)		R
AnIn7	MV	Analogue input (7)		R
AnIn8	MV	Analogue input (8)		R
AnIn9	MV	Analogue input (9)		R

AnIn10	MV	Analogue input (10)		R
AnIn11	MV	Analogue input (11)		R
AnIn12	MV	Analogue input (12)		R
AnIn13	MV	Analogue input (13)		R
AnIn14	MV	Analogue input (14)		R
AnIn15	MV	Analogue input (15)		R
AnIn16	MV	Analogue input (16)		R
AnIn17	MV	Analogue input (17)		R
AnIn18	MV	Analogue input (18)		R
AnIn19	MV	Analogue input (19)		R
AnIn20	MV	Analogue input (20)		R
AnIn21	MV	Analogue input (21)		R
AnIn22	MV	Analogue input (22)		R
AnIn23	MV	Analogue input (23)		R
AnIn24	MV	Analogue input (24)		R
AnIn25	MV	Analogue input (25)		R
AnIn26	MV	Analogue input (26)		R
AnIn27	MV	Analogue input (27)		R
AnIn28	MV	Analogue input (28)		R
AnIn29	MV	Analogue input (29)		R
AnIn30	MV	Analogue input (30)		R
AnIn31	MV	Analogue input (31)		R
AnIn32	MV	Analogue input (32)		R
AnIn33	MV	Analogue input (33)		R
AnIn34	MV	Analogue input (34)		R
AnIn35	MV	Analogue input (35)		R
AnIn36	MV	Analogue input (36)		R
AnIn37	MV	Analogue input (37)		R
AnIn38	MV	Analogue input (38)		R
AnIn39	MV	Analogue input (39)		R
AnIn40	MV	Analogue input (40)		R
AnIn41	MV	Analogue input (41)		R
AnIn42	MV	Analogue input (42)		R
AnIn43	MV	Analogue input (43)		R
AnIn44	MV	Analogue input (44)		R
AnIn45	MV	Analogue input (45)		R
AnIn46	MV	Analogue input (46)		R
AnIn47	MV	Analogue input (47)		R
AnIn48	MV	Analogue input (48)		R
AnIn49	MV	Analogue input (49)		R
AnIn50	MV	Analogue input (50)		R
AnIn51	MV	Analogue input (51)		R
AnIn52	MV	Analogue input (52)		R
AnIn53	MV	Analogue input (53)		R
AnIn54	MV	Analogue input (54)		R
AnIn55	MV	Analogue input (55)		R
AnIn56	MV	Analogue input (56)		R
AnIn57	MV	Analogue input (57)		R
AnIn58	MV	Analogue input (58)		R
AnIn59	MV	Analogue input (59)		R
AnIn60	MV	Analogue input (60)		R

AnIn61	MV	Analogue input (61)		R
AnIn62	MV	Analogue input (62)		R
AnIn63	MV	Analogue input (63)		R
AnIn64	MV	Analogue input (64)		R
Controls				
SPCSO	SPC	Single point controllable status output		O
DPCSO	DPC	Double point controllable status output		O
ISCSO1	INC	Integer status controllable status output (1)		R
ISCSO2	INC	Integer status controllable status output (2)		R
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		O
Ind	SPS	General indication (binary input)		O

NOTES:

Controls → ISCSO1: measurements [1…32] availability bitmask (according to the order specified in GSTP011)

Controls → ISCSO2: measurements [33…64] availability bitmask (according to the order specified in GSTP011) - reserved for future use/development

Measured Values → AnIn1: for mapping the measurement of the phase-to-phase Voltage V_{12-4} (RMS value in kV) at the generator terminals (single-pole or three-pole depending on the type of inverter) issued by possible IDC_DER

Measured Values → AnIn2: for mapping the measurement of the phase-to-phase Voltage V_{4-8} (RMS value in kV) at the generator terminals (single-pole or three-pole depending on the type of inverter) issued by possible IDC_DER

Measured Values → AnIn3: for mapping the measurement of the phase-to-phase Voltage V_{8-12} (RMS value in kV) at the generator terminals (single-pole or three-pole depending on the type of inverter) issued by possible IDC_DER

Measured Values → AnIn4: for mapping the measurement of the frequency (Hz) at the generator terminals, issued by possible IDC_DER

Measured Values → AnIn5: for mapping the measurement of P (kW) absorbed by the Load, issued by possible IDC_DER

Measured Values → AnIn6: for mapping the measurement of Q (kVAr) absorbed by the Load, issued by possible IDC_DER

Measured Values → AnIn7: for mapping the measurement of P (kW) absorbed by the Interruptible Load, issued by possible IDC_DER

Measured Values → AnIn8: for mapping the measurement of Q (kVAr) absorbed by the Interruptible Load, issued by possible IDC_DER

Measured Values → AnIn9: for mapping the measurement of P (kW) of the storage, issued by possible IDC_DER

Measured Values → AnIn10: for mapping the measurement of Q (kVAr) of the storage, issued by possible IDC_DER

Measured Values → AnIn11: for mapping the measurement of the actual storage capacity (% of the rated capacity), issued by possible IDC_DER

Measured Values → AnIn12: for mapping the measurement of the state of charge of the storage (% of the actual capacity), issued by possible IDC_DER

Measured Values → AnIn13: for mapping the measurement of the residual charge/discharge cycles (integer) of the storage, issued by possible IDC_DER

Measured Values → AnIn14: for mapping the measurement of P exchanged with the MV grid (kW), issued by possible IDC_DER

Measured Values → AnIn15: for mapping the measurement of Q exchanged with the MV grid (kVAr), issued by possible IDC_DER

Measured Values → AnIn16: reserved for future use/development

Measured Values → AnIn17: for mapping the measurement of the P (kW) generated by the photovoltaic generation system, issued by possible IDC_DER

Measured Values → AnIn18: for mapping the measurement of the Q (kVAr) generated by the photovoltaic generation system, issued by possible IDC_DER

Measured Values → AnIn19: for mapping the measurement of the P (kW) generated by the wind power generation system, issued by possible IDC_DER

Measured Values → AnIn20: for mapping the measurement of the Q (kVAr) generated by the wind power generation system, issued by possible IDC_DER

Measured Values → AnIn21: for mapping the measurement of the P (kW) generated by the thermal power generation system, issued by possible IDC_DER

Measured Values → AnIn22: for mapping the measurement of the Q (kVAr) generated by the thermal power generation system, issued by possible IDC_DER

Measured Values → AnIn23: for mapping the measurement of the P (kW) generated by the hydro **power** generation system, issued by possible IDC_DER

Measured Values → AnIn24: for mapping the measurement of the Q (kVAr) generated by the hydro power generation system, issued by possible IDC_DER

Measured Values → AnIn25: for mapping the measurement of the P (kW) generated by other sources of power generation, issued by possible IDC_DER

Measured Values → AnIn26: for mapping the measurement of the Q (kVAr) generated by other sources of power generation, issued by possible IDC_DER

Measured Values → AnIn27: reserved for future use/development

Measured Values → AnIn28: reserved for future use/development

Measured Values → AnIn29: reserved for future use/development

Measured Values → AnIn30: reserved for future use/development

Measured Values → AnIn31: reserved for future use/development

Measured Values → AnIn32: reserved for future use/development

Measured Values → AnIn33…64: reserved for future use/development.

This LN is ready to receive the above specified information (bitmasks excluded as configured in the RGDM) as inputs via GOOSE issued by the possible IDC_DER.

7.6 Virtual Input/Output Logical Device: details of the Logical Nodes

The Virtual Input/Output Logical Device (LD_VIO) contains all the LNs used to model experimental inputs and outputs ready for any future use/development.

LLN01 type				
Attribute Name	**Attribute Type**	**Explanation**	**T**	**M/O**
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
Loc	SPS	Local operation for complete logical device		O

OpTmh	INS	Operation Time		O
Controls				
Diag	SPC	Run Diagnostic		O
LEDRs	SPC	LED reset	T	O

type :LPHD2 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	**T**	**M/O**
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
PhyNam	DPL	Physical device name plate		M
PhyHealth	INS	Physical device health		M
OutOv	SPS	Output communications buffer overflow		O
Proxy	SPS	Indicates if this LN is a proxy		M
InOv	SPS	Input communications buffer overflow		O
NumPwrUp	INS	Number of Power ups		O
WrmStr	INS	Number of Warm Starts		O
WacTrg	INS	Number of watchdog device resets detected		O
PwrUp	SPS	Power Up detected		O
PwrDn	SPS	Power Down detected		O
PwrSupAlm	SPS	External power supply alarm		O
RsStat	SPC	Reset device statistics	T	O

7.6.1 Virtual Input

Table 84 - type:GGIO17 - prefix: VIn01 - LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO	SPC	Single point controllable status output		R
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		R
Ind	SPS	General indication (binary input)		O

LNInstance: 1 - prefix: VIn02..VIn31

Same LN Type.

Table 85 – type:GGIO17 – prefix: VIn32 – LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		R
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO	SPC	Single point controllable status output		R
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		R
Ind	SPS	General indication (binary input)		O

NOTES:

Common Logical Node Information→ OpCntRs: to count and store the number of State variations

Controls→ SPCSO: available/ready Input n (n = 1..32)

Controls→ Alm: available/ready signalling n (n = 1..32).

7.6.2 Virtual Output

Table 86 – type: GGIO18 – prefix: VOut – LNInstance: 1				
Attribute Name	**Attribute Type**	**Explanation**	T	M/O
LNName		Shall be inherited from Logical Node Class (IEC 61850-7-2)		
Data				
Common Logical Node Information				
		LN shall inherit all Mandatory Data from Common Logical Node Class		M
EEHealth	INS	External equipment health (external sensor)		O
EEName	DPL	External equipment name plate		O
Loc	SPS	Local operation		O
OpCntRs	INC	Resetable operation counter		O
Measured values				
AnIn	MV	Analogue input		O
Controls				
SPCSO	SPC	Single point controllable status output		O
DPCSO	DPC	Double point controllable status output		O
ISCSO	INC	Integer status controllable status output		O
Status Information				
IntIn	INS	Integer status input		O
Alm	SPS	General single alarm		O
Ind1	SPS	General indication (binary input)		R
Ind2	SPS	General indication (binary input)		R
Ind3	SPS	General indication (binary input)		R

Ind4	SPS	General indication (binary input)		R
Ind5	SPS	General indication (binary input)		R
Ind6	SPS	General indication (binary input)		R
Ind7	SPS	General indication (binary input)		R
Ind8	SPS	General indication (binary input)		R
Ind9	SPS	General indication (binary input)		R
Ind10	SPS	General indication (binary input)		R
Ind11	SPS	General indication (binary input)		R
Ind12	SPS	General indication (binary input)		R
Ind13	SPS	General indication (binary input)		R
Ind14	SPS	General indication (binary input)		R
Ind15	SPS	General indication (binary input)		R
Ind16	SPS	General indication (binary input)		R

NOTES:

Controls→ Ind1: available/ready Output 1

Controls→ Ind2: available/ready Output 2

Controls→ Ind3: available/ready Output 3

Controls→ Ind4: available/ready Output 4

Controls→ Ind5: available/ready Output 5

Controls→ Ind6: available/ready Output 6

Controls→ Ind7: available/ready Output 7

Controls→ Ind8: available/ready Output 8

Controls→ Ind9: available/ready Output 9

Controls→ Ind10: available/ready Output 10

Controls→ Ind11: available/ready Output 11

Controls→ Ind12: available/ready Output 12

Controls→ Ind13: available/ready Output 13

Controls→ Ind14: available/ready Output 14

Controls→ Ind15: available/ready Output 15

Controls→ Ind16: available/ready Output 16.

8 ASPECTS OF DATA COMMUNICATION MODELED UNDER IEC61850

This chapter is based on the implementation of GOOSE messages on WAN (between HV/MV DS - MV/LV DS and MV/LV DS - MV/LV DS).

Figure 3 describes the set of protocol stacks and communication services defined in the IEC61850 standard and used to communicate with the IEDs of the HV/MV SS, MV/LV SS and DER plants.

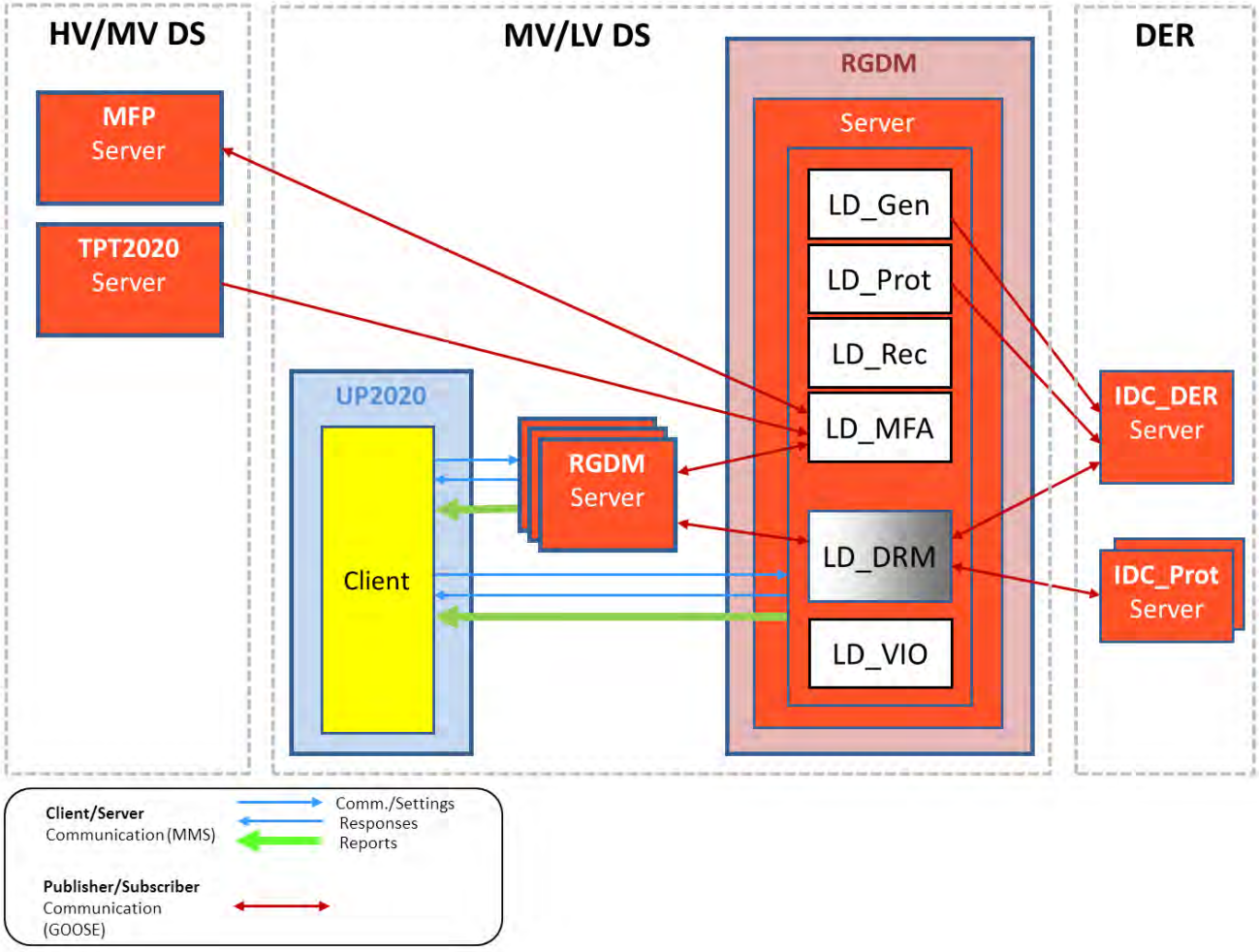

Figure 3 – IEC 61850 Communication Streams and Services

The RGDM has (for legacy) the role of an intermediary in the communication between the Client in the MV/LV DS, the MFP in the HV/MV DS and the DER plant (possible IDC_Prot and IDC_DER). In particular, the UPG function converts the client/server communication in server/server communication and vice versa.

The RGDM uses Client/Server messaging to communicate with the UP2020 Lite in the DS, according to the following architecture and protocols (ref. IEEE 802.1Q):

a. 7 OSI Layers,

b. ACSI via MMS via TCP/IP via ISO/IEC 8802-3,

c. Unicast,

For commands/controls, configurations, periodic spontaneous reporting or events.

The IED will also interoperate with other Servers (in the HV/MV DS and in the DER Plant) via GOOSE according to IEEE 802.1Q:

d. 3 OSI Layers,

e. GOOSE via ISO/IEC 8802-3 via IEEE 802.1Q (Virtual LAN),

f. Multicast,

For bay/field automation (BLIND, Remote Trip, Remote Close, TDLP) and DER management.

A spreadsheet filewith the specification of the communication interfaces described in Figure 3 will be provided by ENEL during the procurement process (ref. Par.9.1).

9 MISCELLANEOUS

This chapter include further requirements, recommendations and additional information.

9.1 Clarification during the procuremen process

By summarizing, during the procurement process the following clarification will be provided to the supplier:

g. The spreadsheet file that specifies the input/output required in GSTP011 according to IEC61850 as described in chapter 7 and 8;

h. The ICD file that implement the formal description of the IED in chapter 7 and 8.

9.2 ICD file revision control

Owing to the changes affecting the information model or the communication of the IED, the following rules are adopted to ensure that the version numbering clearly identifies each variation or iteration of the ICD file.

<Header id = "IEDxxx ENEL" version = "v" revision = "rrr" toolID = "" nameStructure = "IEDName" />

a. version is an integer increased by one unit for major releases (e.g. during the prototyping it will be 1, in operation it will be 2 or more),

b. revision is an integer increased by one unit for minor releases due to some new feature (affecting the Data Model or the Communication) or bug fix. It is reset to zero when the version changes.

<ReportControl … confRev="c" datSet="xxx"…/>

<GSEControl … confRev="c" datSet="xxx" …/>

The confRev, by IEC 61850 standard, is an integer starting from "1" that increments

c. when the referenced *datSet* is changed,

d. when the Report or the GOOSE control block itself is modified,

e. the counter is never reset.

For example, the attached ICD file may have

Header

f. version = "2" (for operation)

g. revision = "0" (no minor revisions since the last major version)

<GSEControl name = "gcb_TDLP"

h. confRev = "3" (due to modified Data Set or Control Block since the prototyping).