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Edition 1.0 2016-10

TECHNICAL REPORT

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Current and voltage sensors or detectors, to be used for fault passage indication purposes –
Part 100: Requirements and proposals for the IEC 61850 series data model extensions to support fault passage indicators applications

IEC TR 62689-100:2016-10(en)

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CURRENT AND VOLTAGE SENSORS OR DETECTORS, TO BE USED FOR FAULT PASSAGE INDICATION PURPOSES –

Part 100: Requirements and proposals for the IEC 61850 series data model extensions to support fault passage indicators applications

FOREWORD

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IEC TR 62689-100, which is a Technical Report, has been prepared by IEC technical committee 38: Instrument transformers, in cooperation with TC 57: Power systems management and associated information exchange.

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

Enquiry draft	Report on voting
38/499/DTR	38/519/RVC

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

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

A list of all parts in the IEC 62689 series, published under the general title *Current and voltage sensors or detectors, to be used for fault passage indication purposes*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This part of IEC 62689 has two main framework constraints with editorial and technical impacts as

- this document will be merged with IEC TR 61850-90-6[1]: IEC TR 62689-100 will exactly stick with the targeted document structure and principles, and
- this document intends to prepare the content of the future IEC 62689-3[2] which will directly rely on the functional requirements expressed in IEC 62689-1 and IEC 62689-2.

1 Under preparation. Stage at the time of publication: IEC PWI 61850-90-6:2016.

2 Under preparation. Stage at the time of publication: IEC PWI 62689-3:2016.

CURRENT AND VOLTAGE SENSORS OR DETECTORS, TO BE USED FOR FAULT PASSAGE INDICATION PURPOSES –

Part 100: Requirements and proposals for the IEC 61850 series data model extensions to support fault passage indicators applications

1 Scope

This part of IEC 62689, which is a Technical Report, was prepared jointly with TC 57 with the scope to prepare requirements and proposals for the IEC 61850 series data model extensions to support fault passage indicators (all classes and extended functions) applications to be introduced in the future IEC 61850-90-6 and that, in turn, will be needed for the preparation of the future IEC 62689-3.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC TS 61850-2, *Communication networks and systems in substations – Part 2: Glossary*

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

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

IEC 62689 (all parts), *Current and voltage sensors or detectors, to be used for fault passage indication purposes*

IEC 62689-1, *Current and voltage sensors or detectors, to be used for fault passage indication purposes – Part 1: General principles and requirements*

IEC 62689-2, *Current and voltage sensors or detectors, to be used for fault passage indication purposes – Part 2: System aspects*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61850-2, IEC 61850-7-2, IEC 62689 (all parts) and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
fault passage indicator
FPI
device able to detect faults providing indications about their localization (upstream or downstream from the FPI's location) and/or about the direction of fault current (usually referred as the direction of load current, i.e. from the HV/MV transformer towards end of MV feeders in a radial operated network)

[SOURCE: IEC 62689-1:2016, 3.1.1, modified — The notes to entry have been deleted.]

3.1.2
substation
substation of a power system
part of a power system, concentrated in a given place, including mainly the terminations of transmission or distribution lines switchgear and housing and which may also include transformers

Note 1 to entry: It generally includes facilities necessary for system security and control (e.g. the protective devices).

Note 2 to entry: Apply as well to overhead and underground equipment.

[SOURCE: IEC 62689-1:2016, 3.1.3, modifed — The term "substation of a power system" has been added as a second preferred term, the last sentence in the definition has been moved to a new note and the notes to entry have been replaced by new a new note.]

3.1.3
distribution substation unit
DSU
distribution automation unit
device (or a combination of devices and/or functions) able to perform, in addition to specific FPI functionalities, additional features, not strictly related to fault detection (for instance remote communication/commands, switch control or breaker control, network automation, distributed energy resources monitoring and control, etc.)

[SOURCE: IEC 62689-1:2016, 3.1.4, modified — The term "distribution automation unit" has been added as an admitted term and the note to entry has been deleted.]

3.2 Abbreviated terms

3.2.1 Generic abbreviated terms

Table 1 presents generic acronyms and abbreviated terms used throughout the document.

Table 1 – Generic acronyms and abbreviated terms

Term	Description
AR	Autorecloser
CB	Circuit Breaker
DER	Distributed Energy Resource
ds	derived statistics
DER MS	DER Management System
DERCtl	DER Unit Controller
DMSapp	DMS application module
DSO	SysOp
ECP	Electrical connection point

Term	Description
EPS	Electrical Power System
FeProt	Feeder protection function
FeCTL	Feeder equipment controller
FieldComp	Field level physical component
FieldSyst	Field level sub system
FLISRapp	FLISR application module
FMS	Electric Network Fault management system
FOP	Field Operation Personnel
FPI	Fault Passage Indicator
FtDet	Fault signature detection
FtInd	Fault Indicator
FtLOCapp	Fault location application module
FtPInd	Fault Passage indicator at feeder level
Ms(I,U)	Electrical measurement
Ms(Wh)	Energy counting for operation
nds	not derived statistics
PCC	Point of common coupling
Planning	Electric Network Planning
PresCond	Presence Condition
QIS	(Electric Network) Quality Index System
RTUapp	Remote terminal gateway function
SysOp	Electric System operator
VPI	Voltage presence indicator
VVCapp	Volt var control Application module

NOTE Refer to Annex A for the terms ds,nds, PresCond.

3.2.2 Proposed specifically for the data model part of this document

Table 2 shows abbreviated terms that are combined to create data object names.

Table 2 – Abbreviated terms for data object names

Term	Description
Abc	Absence
All	All
Cid	Configuration file (CID)
Cus	customer
Def	Default
Evo	Evolution, Evolutive
Hdl	Handle, Handling
Itm	Intermittent
Ms	measurement
New	New

Term	Description
Abc	Absence
Ot	Outage
Oth	Other
Pm	Permanent
Q	Quadrant
Run	Run
Sfx	Self-extinguishing
Spm	Semi-permanent
To	To (preposition)

3.2.3 Existing abbreviated terms used in IEC 61850 (all parts) data object names model

Table 3 shows abbreviated terms of IEC 61850 (all parts) that are combined to create data object names.

Table 3 – Abbreviated terms of IEC 61850 (all parts) for data object names

Term	Description
A	Current; phase A (L1)
AC	AC, alternating current
AGC	Automatic generation control
ASG	Analogue setting CDC
AWatt	Wattmetric component of current
Abr	Abrasion
Abs	Absolute
Absb	Absorbing
Acc	Accuracy; acceleration (deprecated: use Accl instead)
Accl	Acceleration
Accm	Accumulated
Ack	Acknowledgement, acknowledge
Acs	Access
Act	Action, activity, active, activate
Actr	Actuator
Acu	Acoustic
Adj	Adjustment
Adp	Adapter, adaptation
Aff	Affected
Age	Ageing
Ahr	Ampere hours
Air	Air
Alg	Algorithm
Alm	Alarm

Term	Description
Alt	Altitude
Amnt	Amount
Amp	Ampere, current DC or non-phase-related AC
An	Analogue
Anc	Ancillary
Ane	Anemometer
Ang	Angle
Ap	Access point
Apc	Analogue point control
App	Apparent
Ar	Amperes reactive (reactive current)
Arc	Arc
Area	Area
Arr	Array
At	At
Auth	Authorisation
Auto	Automatic
Aux	Auxiliary
Av	Average
Avl	Availability
Ax	Axial
Azi	Azimuth
B	Bushing; phase B (L2)
BG	Before Gain

Term	Description
Bac	Binary-controlled analogue value
Base	Base
Bat	Battery
Bck	Backup
Bec	Beacon
Beh	Behaviour
Ber	Bit error rate
Bias	Bias
Bl	Blade
Blb	Bulb
Blk	Block, blocked
Blow	Blowby
Bnd	Band, bandwidth
Boil	Boiler
Bot	Bottom
Brcb	Buffered report control block
Brg	Bearing
Brk	Brake
Bsc	Binary status control
Bst	Boost
Bt	Heartbeat
Bus	Bus
C	Carbon; phase C (L3)
C2H2	Acetylene
C2H4	Ethylene
C2H6	Ethane
CB	Circuit breaker
CE	Cooling equipment (see also Cl)
CG	Core ground
CH4	Methane
CHP	Combined heat and power
CO	Carbon monoxide
CO2	Carbon dioxide
Cab	Cable
Cal	Calorie, caloric
Cam	Cam, e.g. rotating non-circular disk
Cap	Capability, capacity
Capac	Capacitance
Car	Carrier
Cbr	Calibration
Ccw	Counter clockwise
Ccy	Currency
Ceil	Ceiling
Cel	Cell

Term	Description
Cf	Crest factor
Cff	Coefficient
Cfg	Configuration
Ch	Channel
Cha	Charger
Chg	Change
Chk	Check
Chr	Characteristic
Circ	Circulating, circuit
Cl	Cooling, coolant, cooling system (see also CE)
Clc	Calculate, calculated
Clip	Clip
Clk	Clock
Cloud	Cloud
Clr	Clear
Cls	Close, closed
Cm	Centimetres
Cmbu	Combustible, combustion
Cmd	Command
Cmpl	Completed, completion, complete
Cmut	Commute, commutator
Cndct	Conductivity
Cnt	Counter
Cntt	Contractual
Cnv	Converter
Col	Coil
Comm	Communication
Comp	Compensation
ConfRev	Configuration revision (confRev from IEC 61850-7-2)
Conn	Connected, connections
Cons	Constant (general)
Cor	Correction
Core	Core
Cost	Cost
Crank	Crank
Crd	Coordination
Crit	Critical
Crl	Correlation
Crp	Creeping, slow movement
Crv	Curve
Csmp	Consumption, consumed
Ctl	Control
Ctr	Center

Term	Description
Cur	Current
Cut	Cut, cut-out, cut-in
Cvr	Cover, cover level
Cw	Clockwise
Cwb	Crowbar
Cyc	Cycle
D	Derivate
DC	DC, direct current
DER	Distributed energy resource
DExt	De-excitation
DPCSO	Double point controllable status output
DQ0	Direct, quadrature, and zero axis quantities
DS	Device state
DT	Daylight saving time
Dam	Dam
Damp	Damping
Date	Date, date and time of action
Day	Day
Db	Deadband
Dcl	DC-link
Dct	Direct
De	De (prefix)
Dea	Dead
Dec	Decrease
Deg	Degrees
Dehum	De-humidifier
Del	Delta
Den	Density
Dep	Dependent
Det	Detected
Detun	Detuning
Dev	Device
Dew	Dew
Dff	Diffuse
Dfl	Deflector (used in Pelton turbines)
Dia	Diaphragm
Diag	Diagnostics
Dif	Differential, difference
Dig	Digital
Dip	Dip
Dir	Direction
Dis	Distance
Dith	Dither

Term	Description
Dl	Delay
Dlt	Delete
Dlv	Delivery
Dmd	Demand
Dn	Down, downstream
Dpc	Double point control
Dpt	Departure
Drag	Drag hand
Dropout	Dropout
Drp	Droop
Drt	Derate
Drtb	Draft tube
Drv	Drive
Dsa	Disable, disabled
Dsc	Discrepancy
Dsch	Discharge
Dscon	Disconnected
Dsp	Displacement
Dtc	Detection
Dur	Duration
Dust	Dust
Dv	Deviation
Dw	Delta Omega
ECP	Electrical connection point
EE	External equipment
EF	Earth fault
EFN	Earth-fault neutriliser (Petersen coil)
ENG	Enumerated status setting CDC
ENS	Enumerated status CDC
EV	Electrical Vehicle
EVSE	EV Supply Equipment
Echo	Echo
Edt	Edit, edited
Efc	Efficiency
El	Elevation
Em	Emission
Emg	Emergency
En	Energy
Ena	Enabled, enable, allow operation
Enc	Enumerated control
Encl	Enclosure
End	End
Eng	Engine
Ent	Entity, entities

Term	Description
Entr	Entry, entries
Env	Environment
Eq	Equalization, equal, equivalent
Err	Error
Est	Estimated
Ev	Evaluation
Evn	Even
Evt	Event
Ex	External
ExIm	Export/import
Exc	Exceeded
Excl	Exclusion
Exp	Expired
Expt	Export
Ext	Excitation
F	Float
FA	Fault arc
FPM	Fuel processing module
Fa	"Fire all" sequence (to thyristors)
Fact	Factor
Fail	Failure
Fan	Fan
Fbc	Field breaker configuration
Fer	Frame error rate
Fil	Filter, filtration system
Fish	Fish
Fix	Fixed
Fld	Field
Fll	Fall
Flm	Flame
Flood	Flood
Flsh	Flash, flashing
Flt	Fault
Flush	Flush
Flw	Flow, flowing
Fol	Follower, following
Forc	Forced
Fu	Fuse
Fuel	Fuel
Full	Full
Fwd	Forward
Gain	Gain
Gas	Gas
Gbx	Gearbox

Term	Description
Gdv	Guide vane
Gen	General
Gn	Generator
Gnd	Ground
GoCBRef	GOOSE control block reference
Gocb	GOOSE control block
Gr	Group
Gra	Gradient
Grd	Guard
Gri	Grid
Gross	Gross
Gs	Grease
Gte	Gate
Gust	Gust
H	Harmonics (phase-related)
H2	Hydrogen
H2O	Water (chemical aspect: liquid, steam, etc.)
HP	Hot point
HPh	Harmonics phase
Ha	Harmonics (non-phase-related AC)
Hd	Head
Health	Health
Heat	Heater, heating, heat (see also Ht)
Hi	High, highest
Hold	Hold
Hor	Horizontal
Horn	Horn
Ht	Heating, heating system (see also Heat)
Htex	Heat-exchanger
Hub	Hub
Hum	Humidity
Hy	Hydraulic, hydraulic system
Hyd	Hydrological, hydro, water
Hys	Hysteresis
Hz	Frequency
Hz1	Frequency at side 1
Hz2	Frequency at side 2
I	Integral, integration
ING	Integer status setting CDC
INS	Integer status CDC
ISCSO	Integer status controllable status output
Ia	Information available

Term	Description
Iafm	Information available force majeure
Iano	Information available non-operative
Ianofo	Information available non-operative forced outage
Ianopca	Information available non-operative planned corrective action
Ianos	Information available non-operative suspended
Ianosm	Information available non-operative scheduled maintenance
Iao	Information available operative
Iaog	Information available operative generating
Iaogfp	Information available operative generating with full performance
Iaogpp	Information available operative generating with partial performance
Iaong	Information available operative non-generating
Iaongel	Information available operative non-generating out of electrical specification
Iaongen	Information available operative non-generating out of environment specification
Iaongrs	Information available operative non-generating requested shutdown
Iaongts	Information available operative non-generating technical standby
Ice	Ice
Id	Identity, identifier
Ieee	IEEE definition
IeeeKH	Proportional gain HF (High Frequency). Defined in IEEE 421.5
IeeeKH1	Proportional gain HF positive. Defined in IEEE 421.5
IeeeKH11	Lead gain HF positive. Defined in IEEE 421.5
IeeeKH17	Lead gain HF negative. Defined in IEEE 421.5
IeeeKH2	Proportional gain HF negative. Defined in IEEE 421.5
IeeeKI	Proportional gain IF (Intermediate Frequency). Defined in IEEE 421.5
IeeeKI1	Proportional gain IF positive. Defined in IEEE 421.5
IeeeKI11	Lead gain IF positive. Defined in IEEE 421.5
IeeeKI17	Lead gain IF negative. Defined in IEEE 421.5
IeeeKI2	Proportional gain IF negative. Defined in IEEE 421.5
IeeeKL	Proportional gain LF (Low Frequency). Defined in IEEE 421.5

Term	Description
IeeeKL1	Proportional gain LF positive. Defined in IEEE 421.5
IeeeKL11	Lead gain LF positive. Defined in IEEE 421.5
IeeeKL17	Lead gain LF negative. Defined in IEEE 421.5
IeeeKL2	Proportional gain LF negative. Defined in IEEE 421.5
IeeeKs1	Gain Ks1. Defined in IEEE 421.5
IeeeKs2	Gain Ks2. Defined in IEEE 421.5
IeeeKs3	Gain Ks3. Defined in IEEE 421.5
IeeeM	Ramptrack lowpass degree M. Defined in IEEE 421.R
IeeeN	Ramptrack overall degree N. Defined in IEEE 421.5
IeeeT1	Time constant T1. Defined in IEEE 421.5
IeeeT10	Time constant T10. Defined in IEEE 421.5
IeeeT11	Time constant T11. Defined in IEEE 421.5
IeeeT2	Time constant T2. Defined in IEEE 421.5
IeeeT3	Time constant T3. Defined in IEEE 421.5
IeeeT4	Time constant T4. Defined in IEEE 421.5
IeeeT7	Time constant T7. Defined in IEEE 421.5
IeeeT8	Time constant T8. Defined in IEEE 421.5
IeeeT9	Time constant T9. Defined in IEEE 421.5
IeeeTH1	Time constant TH1 (High frequency positive). Defined in IEEE 421.5
IeeeTH10	Time constant TH10 (High frequency negative). Defined in IEEE 421.5
IeeeTH11	Time constant TH11 (High frequency negative). Defined in IEEE 421.5
IeeeTH12	Time constant TH12 (High frequency negative). Defined in IEEE 421.5
IeeeTH2	Time constant TH2 (High frequency positive). Defined in IEEE 421.5
IeeeTH3	Time constant TH3 (High frequency positive). Defined in IEEE 421.5
IeeeTH4	Time constant TH4 (High frequency positive). Defined in IEEE 421.5
IeeeTH5	Time constant TH5 (High frequency positive). Defined in IEEE 421.5
IeeeTH6	Time constant TH6 (High frequency positive). Defined in IEEE 421.5
IeeeTH7	Time constant TH7 (High frequency negative). Defined in IEEE 421.5
IeeeTH8	Time constant TH8 (High frequency negative). Defined in IEEE 421.5

Term	Description
IeeeTH9	Time constant TH9 (High frequency negative). Defined in IEEE 421.5
IeeeTI1	Time constant TI1 (Intermediate frequency positive). Defined in IEEE 421.5
IeeeTI10	Time constant TI10 (Intermediate frequency negative). Defined in IEEE 421.5
IeeeTI11	Time constant TI11 (Intermediate frequency negative). Defined in IEEE 421.5
IeeeTI12	Time constant TI12 (Intermediate frequency negative). Defined in IEEE 421.5
IeeeTI2	Time constant TI2 (Intermediate frequency positive). Defined in IEEE 421.5
IeeeTI3	Time constant TI3 (Intermediate frequency positive). Defined in IEEE 421.5
IeeeTI4	Time constant TI4 (Intermediate frequency positive). Defined in IEEE 421.5
IeeeTI5	Time constant TI5 (Intermediate frequency positive). Defined in IEEE 421.5
IeeeTI6	Time constant TI6 (Intermediate frequency positive). Defined in IEEE 421.5
IeeeTI7	Time constant TI7 (Intermediate frequency negative). Defined in IEEE 421.5
IeeeTI8	Time constant TI8 (Intermediate frequency negative). Defined in IEEE 421.5
IeeeTI9	Time constant TI9 (Intermediate frequency negative). Defined in IEEE 421.5
IeeeTL1	Time constant TL1 (Low frequency positive). Defined in IEEE 421.5
IeeeTL10	Time constant TL10 (Low frequency negative). Defined in IEEE 421.5
IeeeTL11	Time constant TL11 (Low frequency negative). Defined in IEEE 421.5
IeeeTL12	Time constant TL12 (Low frequency negative). Defined in IEEE 421.5
IeeeTL2	Time constant TL2 (Low frequency positive). Defined in IEEE 421.5
IeeeTL3	Time constant TL3 (Low frequency positive). Defined in IEEE 421.5
IeeeTL4	Time constant TL4 (Low frequency positive). Defined in IEEE 421.5
IeeeTL5	Time constant TL5 (Low frequency positive). Defined in IEEE 421.5
IeeeTL6	Time constant TL6 (Low frequency positive). Defined in IEEE 421.5
IeeeTL7	Time constant TL7 (Low frequency negative). Defined in IEEE 421.5

Term	Description
IeeeTL8	Time constant TL8 (Low frequency negative). Defined in IEEE 421.5
IeeeTL9	Time constant TL9 (Low frequency negative). Defined in IEEE 421.5
IeeeTw1	Time constant wash out Tw1. Defined in IEEE 421.5
IeeeTw2	Time constant wash out Tw2. Defined in IEEE 421.5
IeeeTw3	Time constant wash out Tw3. Defined in IEEE 421.5
IeeeTw4	Time constant wash out Tw4. Defined in IEEE 421.5
IeeeVHMax	Maximum limit set-point HF. Defined in IEEE 421.5
IeeeVHMin	Minimum limit set-point HF. Defined in IEEE 421.5
IeeeVIMax	Maximum limit set-point IF. Defined in IEEE 421.5
IeeeVIMin	Minimum limit set-point IF. Defined in IEEE 421.5
IeeeVLMax	Maximum limit set-point LF. Defined in IEEE 421.5
IeeeVLMin	Minimum limit set-point LF. Defined in IEEE 421.5
IeeeVsi1Max	Input High Limit 1. Defined in IEEE 421.5
IeeeVsi1Min	Input Low Limit 1. Defined in IEEE 421.5
IeeeVsi2Max	Input High Limit 2. Defined in IEEE 421.5
IeeeVsi2Min	Input Low Limit 2. Defined in IEEE 421.5
IeeeVstMax	Output High Limit. Defined in IEEE 421.5
IeeeVstMin	Output Low Limit. Defined in IEEE 421.5
Imb	Imbalance
Imp	Impedance non-phase-related AC
Impact	Impact
Impt	Import
In	Input
Ina	Inactivity
Inc	Integer control
Incr	Increment, increase
Ind	Indication
Indp	Independent
Iner	Inertia
Inh	Inhibit
Inl	Inline
Inlet	Inlet
Ins	Insulation

Term	Description
Insol	Insolation
Inst	Instantaneous
Int	Integer
Intm	Intermediate
Intn	Internal
Intr	Interrupt, interruption
Intv	Interval
Inv	Inverter, inverted, inverse
Isc	Integer status control
Isld	Islanded
Iso	Isolation
Iu	Information unavailable
Ix	Index
Jmp	Jump
Jnt	Joint
K	Constant (regulation)
K0Fact	Zero-sequence (residual) compensation factor
KFact	K factor (harmonics)
Kck	Kicker
Key	Key, physical control device
L	Lower (action)
LDC	Line drop compensation
LDCR	Line drop compensation resistance
LDCX	Line drop compensation reactance
LDCZ	Line drop compensation impedance
LED	Light-emitting diode
LTC	Load tap changer
Last	Last
Ld	Lead
Leap	Leap (second)
Len	Length
Lev	Level
Lft	Lifting, lift
Lg	Lag
Life	Lifetime
Lim	Limit
Lin	Line
Liv	Live
Lkd	Locked
Lkg	Leakage
Ll	Last long (interval)
Lo	Low (state or value)
Loc	Local

Term	Description
Locb	Log control block
Lod	Load, loading
Log	Log
Lok	(use Lkd instead) Locked
Loop	Loop
Los	Loss
Ls	Last short (interval)
Lst	List
Lub	Lubrication
Lum	Luminosity
M	Minutes
MV	Measured value CDC
Made	Made
Mag	Magnetic, magnitude
Maint	Maintenance
Man	Manual
Mat	Material
Max	Maximum
Mbr	Membrane
Mdul	Module
Mech	Mechanical
Media	Media
Mem	Memory
Min	Minimum
Mlt	Multiple
Mod	Mode
Mot	Motor
Mrk	Market
Mst	Moisture
Msvcb	Multicast sampled values control block
Mth	Method
Mult	Multiplier
Mvm	Movement, moving
N2	Nitrogen
NOx	Nitrogen oxide
NQS	Average partial discharge current
Nam	Name
Name	Name (reserved for use in data objects EEName and LNName only)
Ndl	Needle (used in Pelton turbines)
NdsCom	Needs commissioning
Neut	Neutral
Ng	Negative
Nhd	Net head

Term	Description
Night	Night
No	No, not
Nom	Nominal, normalising
Num	Number
Nxt	Next
O2	Oxygen
O3	Ozon, trioxygen
Obl	Obligation
Oc	Open circuit
Odd	Odd
Of	Offline
Off	Off, device disengaged, not running
Ofs	Offset
Oil	Oil
On	On, device applied, running
Oo	Out of
Op	Operate, operating, operation
Operate	Operate order to any device
Opn	Open, opened
Out	Output
Ov	Over, override, overflow
Ovl	Overload
Ox	Oxidant
P	Proportional
PF	Power factor
PH	Acidity, value of pH
PNV	Phase-to-neutral voltage
POW	Point on wave switching
PP	Phase to phase
PPV	Phase to phase voltage
PT1	Low-pass exponential time rate filter
Pa	Partial
Pair	Pair, paired
Pap	Paper
Par	Parallel
Pas	Passive
Pcb	Power quality qualifier bin
Pct	Percent, percentage
Pdm	Power quality demodulation
Pe	Electric Power
Per	Periodic, period
Ph	Phase to reference
Phs	Phase
Phy	Physical

Term	Description
Pi	Instantaneous real power
Pin	Pin
Pipe	Pipe
Pk	Peak
Pl	Plant
Plg	Plug
Pls	Pulse
Plt	Plate; long-term flicker severity
Pmp	Pump
Po	Polar
Pol	Polarizing
Polytr	Polytropic
Pos	Position
Pot	Potentiometer
Prc	Price, pricing
Pre	Pre-
Prec	Precondition, initial status
Pres	Pressure
Prg	Progress, in progress
Prm	Permissive
Pro	Protection
Proc	Process
Proxy	Proxy
Prt	Parts, part
Ps	Positive
Psk	Penstock
Pss	PSS, power system stabiliser function
Pst	Post, short-term flicker severity
Pt	Point
Pth	Pitch
Pwr	Power
Qty	Quantity
Qu	Queue
Qud	Quad
R	Raise, increase
Rad	Radiation
Ral	Rail
Ramp	Ramp
Rat	Ratio
Rb	Runner blade
Rcd	Record, recording
Rch	Reach
Rcl	Reclaim
Rct	Reaction

Term	Description
Rdy	Ready
Re	Retry
React	Reactance, reactive
Rec	Reclose
Rec1	Reclose after single phase fault
Rec13	Reclose after evolving fault
Rec3	Reclose after three phase fault
Recha	Recharge, recharging
Rect	Rectifier
Red	Redundant; (deprecated meaning) reduction
Ref	Reference
Reg	Regulation
Rel	Release
Req	Requested
Res	Residual
Reso	Resonance
Reuse	Reuse
Rf	Refreshment
Ris	Resistance
Rl	Relation, relative
Rm	Mutual resistance
Rmp	Ramping, ramp
Rms	Root mean square
Rn	Rain
Rnbk	Runback
Rng	Range
Rod	Rod
Root	Root
Rot	Rotation, rotor
Rpt	Repeat, repetition
Rs	Reset, resettable
Rsl	Result
Rst	Restraint, restriction
Rsv	Reserve
Rt	Ride-through
Rte	Rate
Rtg	Rating
Rv	Reverse
Rvrt	Revert
Rwy	Runaway, e.g. in runaway speed
Rx	Receive, received
S10	Coefficient S1.0
S12	Coefficient S1.2

Term	Description
SM	Servo, servo-motor
SNL	Speed-no-load, connected but not generating
SOx	Sulphur oxide
SPCSO	Single point controllable status output
SPG	Single point setting CDC
SPS	Single point status CDC
SPl	Single pole/phase
ST	Standard time
Saf	Safety
Sag	Sag
Sar	Surge arrestor
Sat	Saturation
Sc	Short circuit
Scale	Scale
Schd	Schedule
Sco	Supply change over
Sec	Security
Sel	Select
Self	Self
Seq	Sequence
Ser	Series, serial
Set	Setting
Sgcb	Setting group control block
Sh	Shunt
Shar	Shared
Shft	Shaft
Sig	Signal
Sign	Sign
Sim	Simulation, simulated
Sld	Solidity
Slnt	Salinity, saline content
Slp	Sleep; slip
Smok	Smoke
Smp	Sampling
Snd	Sound pressure
Snpt	Snapshot
Snr	Signal to noise ratio
Snw	Snow
Soc	State of charge
Sof	Switch on to fault
Spc	Single point control
Spcf	Specific
Spd	Speed

Term	Description
Spec	Spectra
Spir	Spiral
Spt	Setpoint
Src	Source
Srfc	Surface
St	Status, state
Sta	Station, function at plant level
Stab	Stabilizer
Stat	Statistics
Stc	Stack
Stdby	Standby
Step	Step
Stk	Stroke
Stl	Still, not moving
Stnd	Stand, standing
Sto	Storage, e.g. activity of storing data
Stop	Stop
Storm	Storm
Stow	Stow
Str	Start
Strg	String
Stt	Stator
Stuck	Stuck, cannot move
Sub	Sub
Sum	Sum
Sup	Supply
Sv	Sampled value
SvCBRef	SV control block reference
Svc	Service
Sw	Switch, switched
Swg	Swing
Swl	Power quality event swell
Syn	Synchronisation, synchronous, synchronism, synchrocheck
Sys	System
TP	Three pole/phase
Ta	Armature time constant
Tag	Tag (maintenance work in progress)
Tap	Tap
Task	Task
Td	Transformer derating
Td0p	Td0'
Td0s	Td0''
Tdd	Total demand distortion

Term	Description
Tdf	Transformer derating factor
Tdp	Td'
Tds	Td''
Tech	Technology
Term	Termination
Test	Test
Tgt	Target
Thd	Total harmonic distortion
Thm	Thermal
Ti	Telephone influence
Tilt	Tilt
Tm	Time
Tm1	Time constant 1
Tm2	Time constant 2
Tm3	Time constant 3
Tmh	Time in h
Tmm	Time in min
Tmms	Time in ms
Tmp	Temperature (°C)
Tms	Time in s
Tnk	Tank
Tns	Tension (stress)
Top	Top (position)
Torq	Torque
Tot	Total
Tp	Test Point
Tpc	Teleprotection
Tq0p	Tq0'
Tq0s	Tq0''
Tqp	Tq'
Tqs	Tq''
Tr	Trip (electrical protection function)
Trf	Transformer
Trg	Trigger
Trip	Trip (non-electrical function)
Trk	Track, tracking
Trs	Transient
Ts	Total signed
Tu	Total unsigned
Tun	Tuning
Tur	Turbine
Tx	Transmit, transmitted
Typ	Type
UPS	Uninterruptible power supply

Term	Description
Uhf	Ultra-high-frequency
Un	Un-; under
Unav	Unavailable
Unb	Unbalanced
Unld	Unload
Unt	Unit, production unit
Up	Up, upstream
Urcb	Unbuffered report control block
Use	Use
Used	Used
Usvcb	Unicast sampled values control block
Util	Utility
V	Voltage
V1	Voltage at side 1
V2	Voltage at side 2
VA	Apparent power (volt amperes)
VAh	Apparent energy
VAr	Reactive power (volt amperes reactive)
VArh	Reactive energy
Va	Variation
Vac	Vacuum
Val	Value
Vbr	Vibration
Ver	Vertical
Viol	Violation
Vis	Visibility
Visc	Viscosity
Vld	Valid, validate, validated
Vlm	Volume
Vlv	Valve
Vol	Voltage DC or non-phase-related AC
VolAmpr	Non-phase-related AC reactive power
W	Active power
W200	Watts peak at 200 W/m2
Wac	Watchdog
Wash	Washout
Watt	Active power non-phase-related AC
Wav	Wave, waveform
Wd	Wind

Term	Description
Week	Week
Wei	Weak end infeed
Wet	Wet
Wh	Watt hours
Wid	Width
Win	Window
Wkup	Wake up
Wld	Welding
Wrm	Warm
Wrn	Warning
Wtr	Water (physical aspect: river, cooling, etc.)
Wup	Windup
X	Reactance (imaginary part of impedance)
X0	Zero sequence reactance
X1	Positive sequence reactance
X2	Negative sequence reactance X2
Xd	Synchronous reactance Xd
Xdir	X-direction
Xdp	Transient synchronous reactance Xd'
Xds	Subtransient reactance Xd''
Xm	Mutual reactance
Xq	Synchronous reactance Xq
Xqp	Transient synchronous reactance Xq'
Xqs	Subtransient reactance Xq''
Xsec	Cross-section
Ydir	Y-direction
Yw	Yaw
Z	Impedance
Zer	Zero
Zero	(use 'Zer' instead) Zero
Zm	Mutual impedance
Zn	Zone
Zro	Zero sequence
km	Kilometre
ppm	Parts per million

3.3 Fault classification definitions

Fault classification: contains the categorization of faults, according to their clearance, referred to in this document, as shown in Table 4.

Table 4 – Fault types

Fault type	Definitions	Notes
Intermittent	Short fault (< 20 ms) appearing every 100 ms to 200 ms	Given durations are only here as examples
Self extinguishing	Duration < protection response time (no tripping)	
Transient	Eliminated by the fast cycle (cycle 1)	
Semi-permanent	Eliminated by the low cycles of recloser (cycle 2 or cycle 3)	
Permanent	Not eliminated by the recloser cycles	
Evolving	Same as permanent fault but the phases in Str Data Object at the end of the fault are not the same as the phases recorded at the beginning of the fault	
Unknown	Unknown type	Different from the above classification

NOTE These definitions align with the conventional usage of “transient” in text books relating to network protection and automation and with the following terms:

- [IEC 60050-614, 614-02-09]

  transient insulation fault

  an insulation fault which only temporarily affects a device's dielectric properties which are restored after a short time
- [IEC 60050-614, 614-02-12]

  intermittent insulation fault

  a transient insulation fault which recurs repeatedly in the same place and due to the same cause
- [IEC 60050-614, 614-02-08]

  permanent insulation fault

  a fault which affects a device and prevents its restoration into service until action has been taken at the point of the insulation fault
- [IEC 60050-614, 614-02-10]

  self-extinguishing insulation fault

  an insulation fault where the arc extinguishes without it being necessary to disconnect the device from the electric power system for its essential dielectric properties to be restored

4 Requirements and use cases

4.1 General

The objective of Clause 4 is to go down to the general high level requirements of information exchanges between a Fault Passage Indicator, as defined in IEC 62689-1 and IEC 62689-2 and the rest of the Distribution Automation Systems (DASs).

These requirements are expressed under the form of use cases as recommended by IEC 62559-2.

The main considered use cases will strictly follow the functional breakdown expressed in IEC 62689-1, and summarised below:

<u>Fault identification and report:</u>

- F1, Fn (refer to FPI function classes – as defined in 62689-1)

<u>Other functions:</u>

- Report on device health
- Monitor substation environment (not developped yet)
- Monitor external communication (not developped yet)
- Monitor energy flow
- Contribute to distributed automatic FLISR
- Contribute to distributed automatic VVC (not developped yet)
- Contribute to distributed DER management

Product life cycle

- IED configuration via CID file

These high level requirements will serve as a starting point for function and data modelling leading to propose new LNs, and/or extension of new LNs with new data objects for the FPI (as expressed in Clause 6), which may feed the IEC 61850-90-6 namespace, when integrated into the corresponding Technical Report.

4.2 Common actors

4.2 and specifically Table 5 contains the list of the actors commonly used in this document. If additional (and specific) actors are needed in the description of the use case, they will be described in the corresponding sublcause dedicated to the given use case.

Figure 1 helps better understanding the global hierarchy of the proposed list of actors, and discriminating between high level actors such as system, persons, devices, application type of actors.

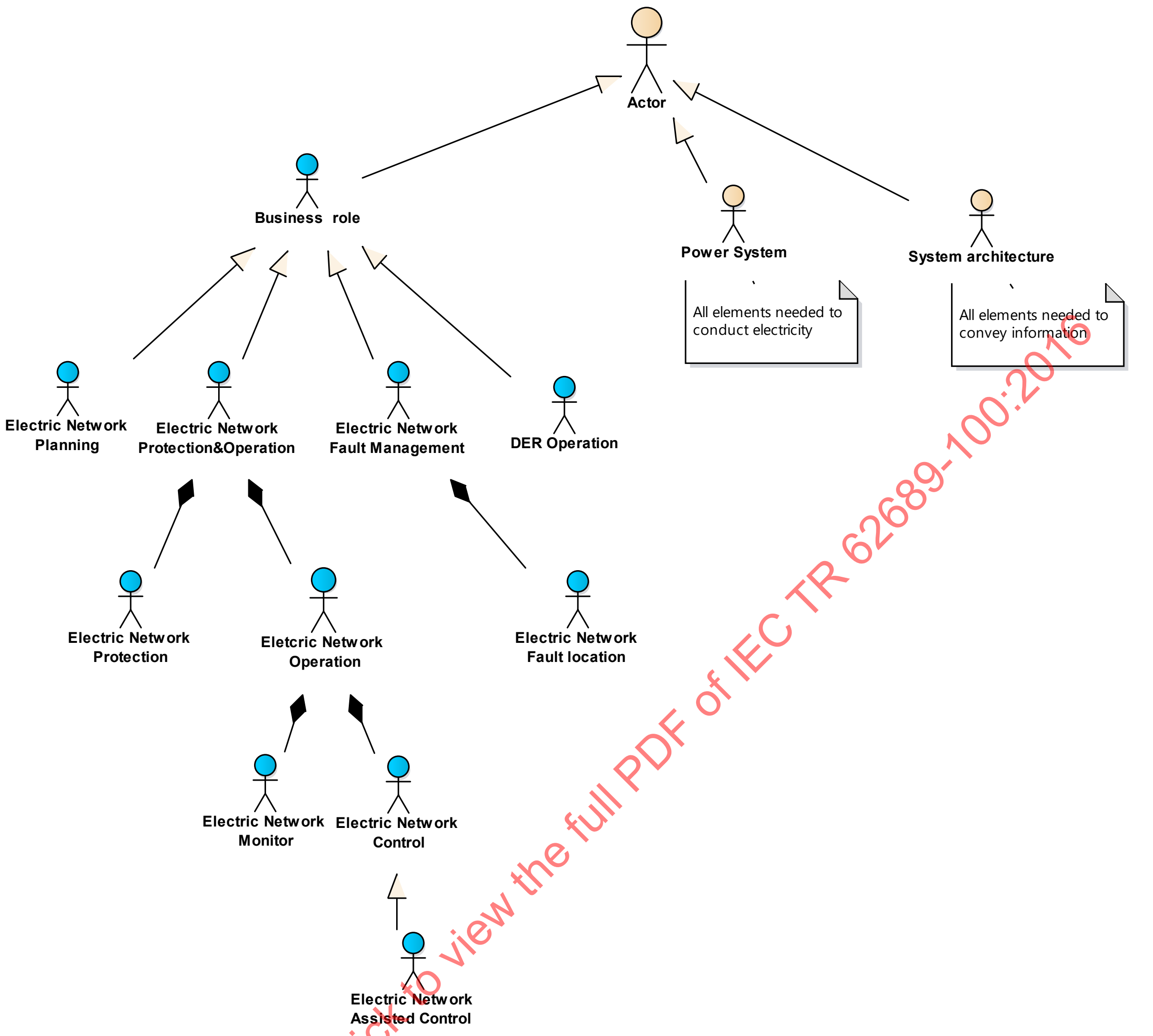


Figure 1 – Actors global hierarchy

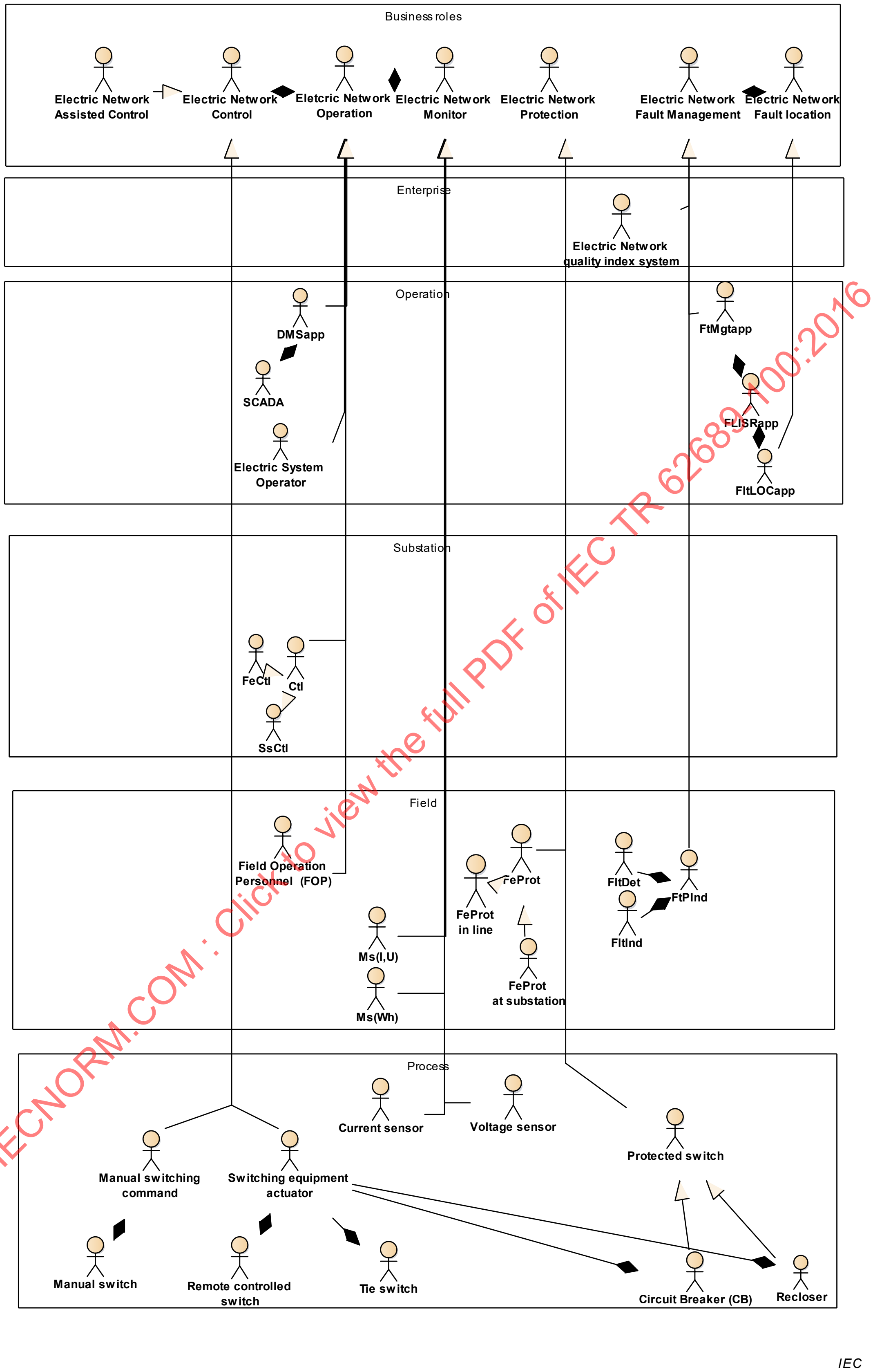


Figure 2 – System Actors SGAM positioning (function)

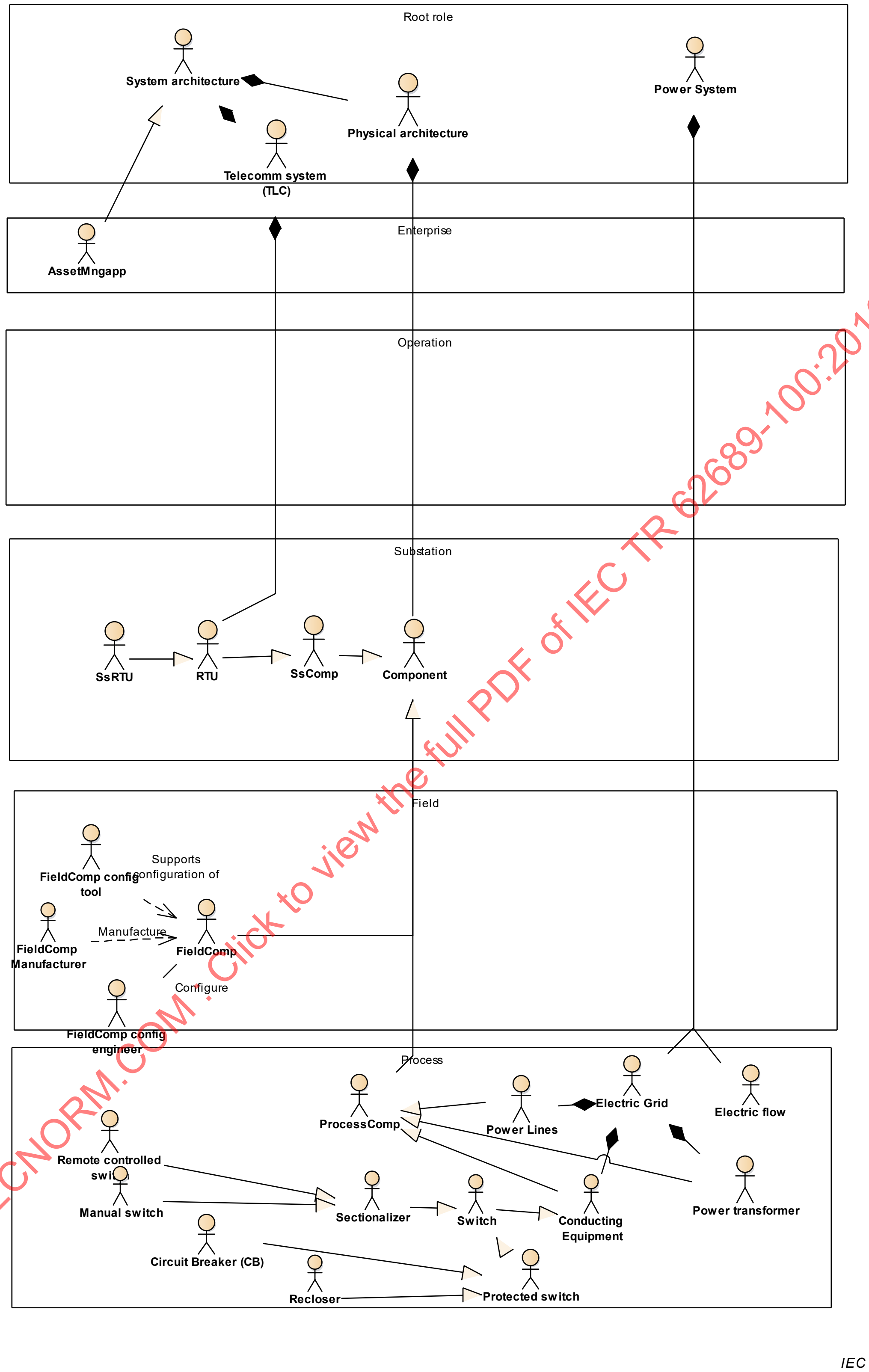


Figure 3 – System Actors SGAM positioning (not function related)

The "system architecture" tree, depicted in Figure 3, designates the "boxes" and "wires" which are used to make the system running. These boxes host a set of functions described in Figure 2, and "wires" support “exchanges” between boxes.

In our case, we focus mostly on components located on the field. For a selected geographical area, a first class at substation level "Component" designates the upper parent class of any of such component (hosting for example the longitude/latitude/altitude). Then they are sorted in 3 sub-families:

- SsComp -> the one located at "substation zone" such as RTU, Substation controller;
- FieldComp -> the one located at "field zone" such as protection relay, power meters;
- ProcessComp -> the one located at "process zone" such as switchgear, breakers, transformers, lines.

Table 5 – List of common actors

Actors			
Actor Name	**Actor Type**	**Actor Description**	**Further information**
Autorecloser (AR)	System field	Function which is located in the field along the feeder to protect the downstream assets by eliminating fault current and having communicating capability to indicate trip conditions to upper levels. This device includes the protection detection function and the recloser function. It also has the ability to be remotely controlled to re-energise the protected feeder.	Electric Network Protection&Operation [field-process]…autorecloser
Controller at distribution substation	System substation	Controller function installed at the substation level which communicates with both the field devices and the control centre. FLISRapp may be implemented at the substation computer as an option.	Electric Network Assisted Control [substation]…controller … substation …distribution
DER Management System (DERMS)	System	The DER MS provides the DER-type-independent communication interface for the communication to the DMS. It forwards the information coming from the DER unit and executes the commands from the DMS.	DER Operation [operation-field]
DER Unit	System process	Distributed energy resources. A DER Unit consists of the physical equipment to generate, store and consume electrical power.	Power system [process]/DER [process]
DER Unit Controller (DERCTL)	System Field	Distributed energy resources. A DER Unit consists of the physical equipment to generate, store and consume electrical power.	DER Operation [field]
SysOp	People	Person who monitors network and identifies the need for and performs or contributes to perform remote operation such as required switching using the FLISRapp Application, or trigerring VVC	Electric Network Operation [Operation]…distribution grid
DMS application module (DMSapp)	System Operation	Refer to IRM. It represents the aggregation of Network Operation, Fault Management, and many others DMS System feature hosted at control centre level that monitors continuously the Grid network and based on a given network topology reflects the energy path and flows.	Electric Network Operation [operation]
Electric Grid	System process	Represent the set of equipment of a distribution feeder including lines, DER, loads, interconnections, switching equipment and voltage transformers.	Power system [process]… distribution … feeder
Electric Network Fault management	System operation	Refer to IRM	Electric Network Fault Management [operation]

Actors			
Actor Name	**Actor Type**	**Actor Description**	**Further information**
Electric Network Planning (Planning)	System enterprise	Refer to IRM	Electric Network Planning [entreprise]
Electric Network quality index system (QIS)	System enterprise	System which collects outage data for reporting to Utility Commissions	Electric Network Fault Management [enterprise]...Network quality logger
Electric System operator (SysOp)	People	Person who monitors network and identifies the need for and performs or contributes to perform required switching using the FLISRApp Application	Electric Network Operation [operation]
Electrical measurement(Ms(I,U))	System field	Function that elaborates electrical measurement such as I, U, P, Q, PF, etc.	Electric Network Protection/Electric Network Operation [field-process]...Electrical measurement
Energy counting for operation (Ms(Wh))	System field	Function that elaborates energy counting (for operational purpose)	Electric Network Protection/Electric Network Operation [field-process]...Energy counting
Power Flow direction computation(Ms(power flow direction))	System field	Function that elaborates the direction of power flow: foreward – from supply or backward – to supply (for operational purpose)	Electric Network Protection/Electric Network Operation [field-process]... Power Flow direction computation
Fault Indicator(FtInd)	System field	Function that identifies the presence of a fault on the Grid.	Electric Network Protection/Electric Network Operation [field-process]...Fault indication
Fault location application module (FtLOCapp)	System operation	Fault location module of a FLISRapp	Electric Network Fault location [operation]...FLISR application module ... fault location
Fault Passage indicator at feeder level (FtPInd)	System field	Function located along the feeder and capable of detecting and indicating a fault. It includes the needed sensors to perform the function.	Electric Network Fault location [field-process]...fault detector ... feeder
Fault signature detection (FtDet)	System field	Function that detects and reports on fault presence (including the update of concerned statistics)	Electric Network Protection/Electric Network Operation [field-process]...Fault signature detection
Electric Network Fault management application module (FtMgtapp)	System operation	Application module which manages or help managing network faults impact and resolution (usually part of an Outage Management application module)	Electric Network Fault Management [operation]...Fault Management application module
Feeder equipment controller (FeCtl)	System substation	Feeder equipment controller located along a feeder, and helping controlling either feeder switching equipement, and possibly a set of equipement connected to the feeder at this connection point (such as a MV/LV transformer, and a LV switchgear)	Electric Network Operation [substation-field]...feeder substation, feeder equipement
Substation controller (SsCtl)	System substation	Susbtation controller helping controlling any equipement, located in a selected substation (such as a HV/MV transformer, HV incomers, MV feeders)	Electric Network Operation [substation-field]... substation, substation equipement

Actors			
Actor Name	**Actor Type**	**Actor Description**	**Further information**
External environment	System	Groups many external element like weather conditions, flooding conditions, live presence status, geographical perimiter status (doors, etc.)	??
adjacent Feeder equipment controller (Adjacent FeCtl)	System substation	Feeder equipment controller located adjacent to a specific other feeder equipment controller, i.e whose attached switching equipement are sharing a same line segment.	Electric Network Operation [substation-field]...feeder substation, feeder equipement...adjacent to()
Feeder equipment controller downstream to fault (Downstream FeCtl)	System substation	Feeder equipment controller located along a feeder, and speciifcally located downstream to a fault.	Electric Network Operation [substation-field]...feeder substation, feeder equipement...downstream to fault
Feeder equipment controller upstream to fault (Upstream FeCtl)	System substation	Feeder equipment controller located along a feeder,and speciifcally located upstream to a fault.	Electric Network Operation [substation-field]...feeder substation, feeder equipement...upstream to fault
Feeder Protection equipment at feeder end substation (FeProt at end substation)	System field	A Feeder Protection equipment located at the other end of the feeder.	Power system [process]/Electric Network Protection [field-process]...Protection equipment .. Feeder protection equipement... at feeder end substation
Feeder In Line Protection equipment (FeProt in line)	System field	A Feeder Protection equipment located within the feeder	Power system [process]/Electric Network Protection [field-process]...Protection equipment .. Feeder protection equipement... in line
Feeder Protection equipment at main substation (FeProt at main substation)	System field	A breaker-type equipement associated with a protection function, located at the main substation to protect an outgoing feeder. It may have communication capability to indicate trip conditions to upper levels. It may also have the ability to be remotely controlled (closed) to re-energise the feeder. It may as well have an autoreclosing function.	Power system [process]/Electric Network Protection /Electric Network Operation[field-process]...Protection equipment .. Feeder protection equipement... at main substation
Feeder Protection function at substation (FeProt at substation)	System field	A function located in the substation that trips a breaker to eliminate fault current in a feeder. It may also reclose the breaker when a preconfigured delay time is expired after the breaker is tripped.	Electric Network Protection /Electric Monitor & control[field]...Protection function ... Feeder Protection function
General Protection function at end-user side (GeneralProt-eu)	System field	A function located at the connecting point of the End User in charge of clearing faults inside its premise.	Electric Network Protection /Electric Monitor & control[field]...Protection function ... Feeder Protection function
Generator Interface protection function (GeneratorInterfaceProt-eu)	System field	A function(s) which are located inside the End User power plant in charge of tripping to disconnect the generators in case of faults in the distribution network.	Electric Network Protection /Electric Monitor & control[field]...Protection function ... Feeder Protection function

Actors			
Actor Name	**Actor Type**	**Actor Description**	**Further information**
Generator Interface disconnection function (GeneratorInterfaceDisconnect-eu)	System field	A function(s) which are located inside the End User power plant in charge of discoonecting the generators when the GeneratorInterfaceProt -eu trips.	Electric Network Protection /Electric Monitor & control[field]…Protection function … Feeder Protection function
Field level physical component (FieldComp)	System susbstation	IEC 61850 physical component of a selected system	System Architecture.. Components [substation-process].. Physical component .. Field
Field level physical component configuration engineer (FieldComp config engineer)	People	Person who is in charge of using a Field level physical component configurator	System Architecture.. Components [substation-process].. Physical component configurator .. Configuration engineer
Field level physical component configurator (FieldComp config tool)	System susbstation	Configurator of an IEC 61850 physical component of a selected system	System Architecture.. Components [substation-process].. Physical component configurator .. Field
Field level physical component setting tool (FieldComp setting tool)	System susbstation	Tool used to enter field parameter settings for an IEC 61850 physical component of a selected system	System Architecture.. Components [substation-process].. Physical component setting tool .. Field
Field level physical feeder sub-system configurator (FieldSyst config tool)	System operation	Configurator of a subsystem made of IEC 61850 physical components including potentially many substation/equipment of a selected feeder or a set of feeders	System Architecture.. Feeder sub-system [operation-process]
Field Operation Personnel (FOP)	People	Person who is activated by people/systems in charge of monitoring network. He performs the required switching operation in filed using the outcome of an overall FLISRapp.	Electric Network Operation [substation-process]
FLISR application module (FLISRapp)	System operation	Application module that performs Fault Location, Isolation and Service Restoration at network operation level	Electric Network Fault location [operation]…FLISR application module
New Field level physical component	System susbstation	New IEC 61850 physical component of a selected system	System Architecture.. Components [substation-process].. Physical component .. Field ..new
ProcessComp	System process	Any physical component (asset, such as switch, breaker, transformer, lines, etc) located at "process zone level". It enables hosting the common properties such physical asset has, such as a physical nameplate, a volume, a location, an age, etc.	System Architecture.. Components [substation-process].. Physical component .. Process
Power Transformer Tap	System process	Taps actuator on transformer windings that change the turns ratio of the transformer	Power system [process] Electric Network Operation rocess]… Power transformer .. Tap
Remote terminal at Substation (Substation RTU)	System substation	Gateway function with the capability of receiving or sending data/control from or to an external source (for example, electronic multifunction meters, digital relays, controllers), ensuring the interface of a substation of field equipment to the remote world. This device may be either a function included in other devices and/or a specific device including	Electric Network Operation [substation].. .gateway … remote terminal

Actors			
Actor Name	**Actor Type**	**Actor Description**	**Further information**
		also the so-called Remote Terminal Units.	
Sectionalizer	System process	Function located along the feeder – sectionalizers/sectionalizing autoreclosers, and switches.	Power system [process]/Electric Network Protection&Operation [process]…sectionalizer
Service Restoration Controller （SRC）	System operation	The function that controls the service restoration of downstream healthy functions of a fault. This function internally gets the support of the role "Operation Planning – switching action scheduling" to estaliblish the switching sequence – this may have been predefined at configuration	Electric Network Assisted Control [operation] …
Shunt Capacitor Switching equipment	System process	Switches associated with shunt capacitors. They can operate automatically through remote communications from the control center, or manually by the field crew.	Power system [process]/Electric Network Operation [field-process]…switching equipement … capacitor shunt
Switching equipment actuator	System process	Primary equipment switches which are located along the grid lines to enable the operator or the system to isolate faulty section. They can be manually operated or remotely/locally operated through the FSCs. In this use case we will restrict our analysis to remotely controllable switches.	Power system /Electric Network Operation [process]…switching equipement …actuator
Switching equipment as Tie switch	System process	A special normally open tie point device function, which is able to sense voltage presence on both sides of its current interrupting mechanism. It also includes the logic to close the interrupting mechanism either automatically upon loss of voltage on one side, or through communication control command. This function can be implemented with recloser, sectionalizer or switch.	Power system [process]…switching equipement (Tie)
Tie switch equipment actuator	System process	Actuator od a Switching equipment operated as a Tie switch	Power system /Electric Network Operation [process]…switching equipement (Tie) …actuator
Voltage presence indicator (VPlind)	System field	A device that indicates the presence of voltage over a certain limit on the measured point. It includes the needed sensors to perform the funciton	Electric Network Fault location [field-process]…voltage detector
VVC application module (VVCapp)	System operation	Application that performs voltage and var control. It determines optimal settings for capacitors and voltage regulators, and either applies them directly to the devices or recommends them to the DSO for approval.	Electric Network Assisted control [operation]…VVC application module

4.3 Use cases: fault indication and report

4.3.1 Generic use case – Not fault type specific

4.3.1.1 Description of the use case

4.3.1.1.1 General

Fault passage indication (FtPInd) is the main purpose of proper devices indicated as Fault passage indicator (FPI) or distribution substation unit (DSU), depending on their performances, which are, respectively, a device or a device/combination of devices and/or functions able to detect faults and provide indications about their localization.

Therefore, fault passage indication (FtPInd) is made of two sub-functions:

- **Fault detection**: detecting abnormal behavior of the grid (usually through predefined fault signatures);
- **Fault indication**: based on different conditions, identifies the type of the fault and exposes it to different types of consumer of information. Optionaly elaborates statistics on faults.

When a fault occurs on the network, the FtPInd needs to detect and identify such fault. Once the fault is identified and possibly confirmed, the FtPInd needs to report to external local or remote components information related to this fault, to allow fault clearing and possible supply restoration, as well as counting fault occurrence based on different criteria.

4.3.1.1.2 Name of the use case

Use case identification		
ID	**Domain(s)**	**Name of the use case**
	Distribution automation	Fault identification and report

4.3.1.1.3 Version management

Version management						
Version management changes / version	**Date**	**Name author(s) or committee**	**Domain expert**	**Area of expertise / domain / role**	**Title**	**Approval status ()**
First version in IEC template	24/08/15	JAHWG51				Draft

4.3.1.1.4 Scope and objectives of the use case

Scope and objectives of use case	
Related business case	Distribution System Operation
Scope	The Distribution Automation (DA) system with the help (or not) of the Operator identifies and locates a fault in a feeder of a radially operated network.
Objective	Contribute to minimise the duration of the supply interruptions. Improve the continuity of service for users connected in MV or LV, by reducing the overall process of fault isolation thanks to automation, therefore reducing the number of customer minutes lost due to outages.

4.3.1.1.5 Narrative of the use case

Narrative of the use case
Short description
The fault detection process (and possible FLISR) is described considering both only local fault indication and different kinds of extra-substation communication, according to FPIs communication classes described in IEC 62689-1. Different types of faults (short circuits, earth faults, etc.) are not considered explicitly, the fault is a generic one. Possible automatic reclosing cycles are not considered in this generic use case.
Complete description
The Fault detection and indication functionalities are (optionally) preliminary set (e.g. by the Field operation personnel). The monitoring of the power system is constantly performed also by the FtPInds located on the radially operated power system under focus. A fault on the power grid can be Permanent or Fugitive. The involved FtPInds (located upstream to the fault) detect the fault signature and indicates to the Field operation personnel or/and to the FtMgtapp, according to its communication class, the information that such fault signature was observed. The Field Operator and the FtMgtapp have the information to perform the further (out of the scope) Fault Isolation and System Restoration actions. The fault event may be reported to the Quality index system to contribute to the quality index calculation.

4.3.1.1.6 General remarks

General Remarks
This use case describes the function of Fault Identification, Location and Report in a network which feeders are radially operated without any MV/MV autotransformer. Currently the use case does not consider the presence of DER. This use case assumes that the feeder has at least one FtPInd located upstream to the fault. The use case applies to feeders with sections of overhead line or underground cable or a mixture of both types.

4.3.1.2 Diagrams of the use case

For the sake of simplifying the diagram, the Quality index system (refer to 4.2) is not represented in Figure 4 to Figure 8. Basically any fault event received by the FtMgtapp should also be received by the Quality index system (refer to 4.2).

Diagram(s) of the use case

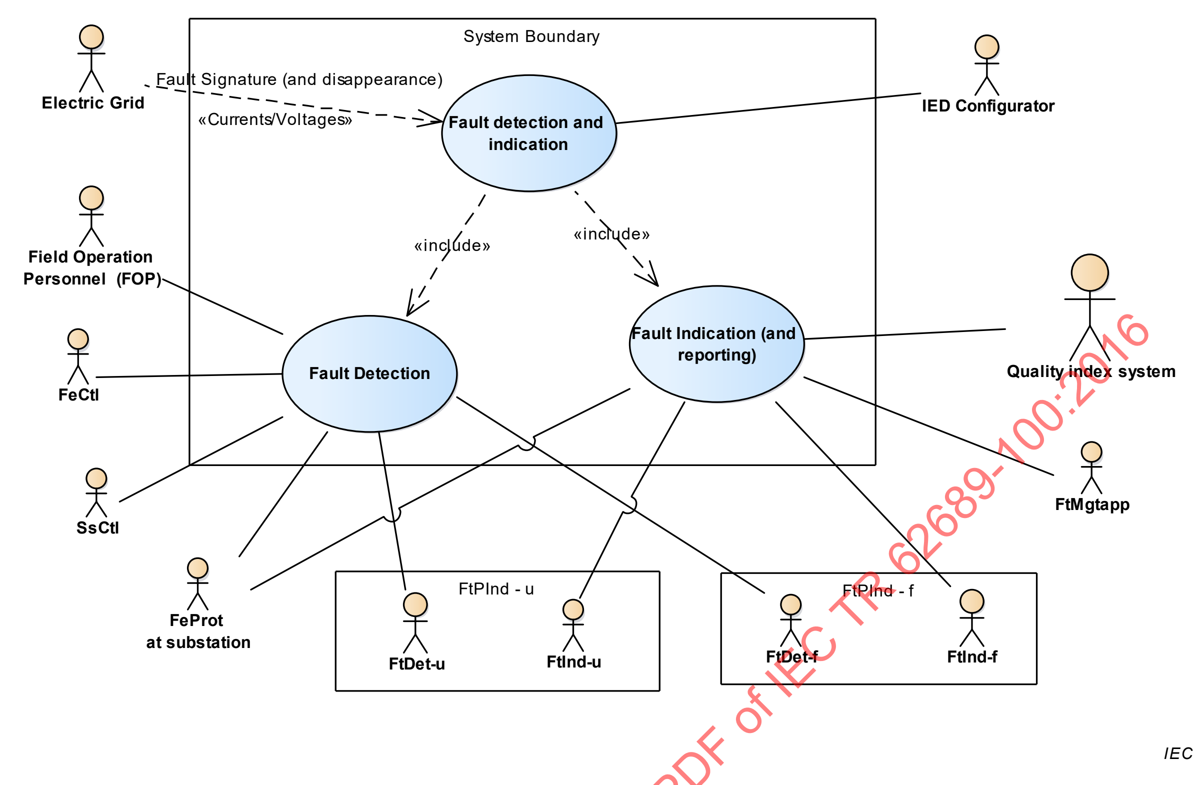


Figure 4 – Fault indication – Main use case

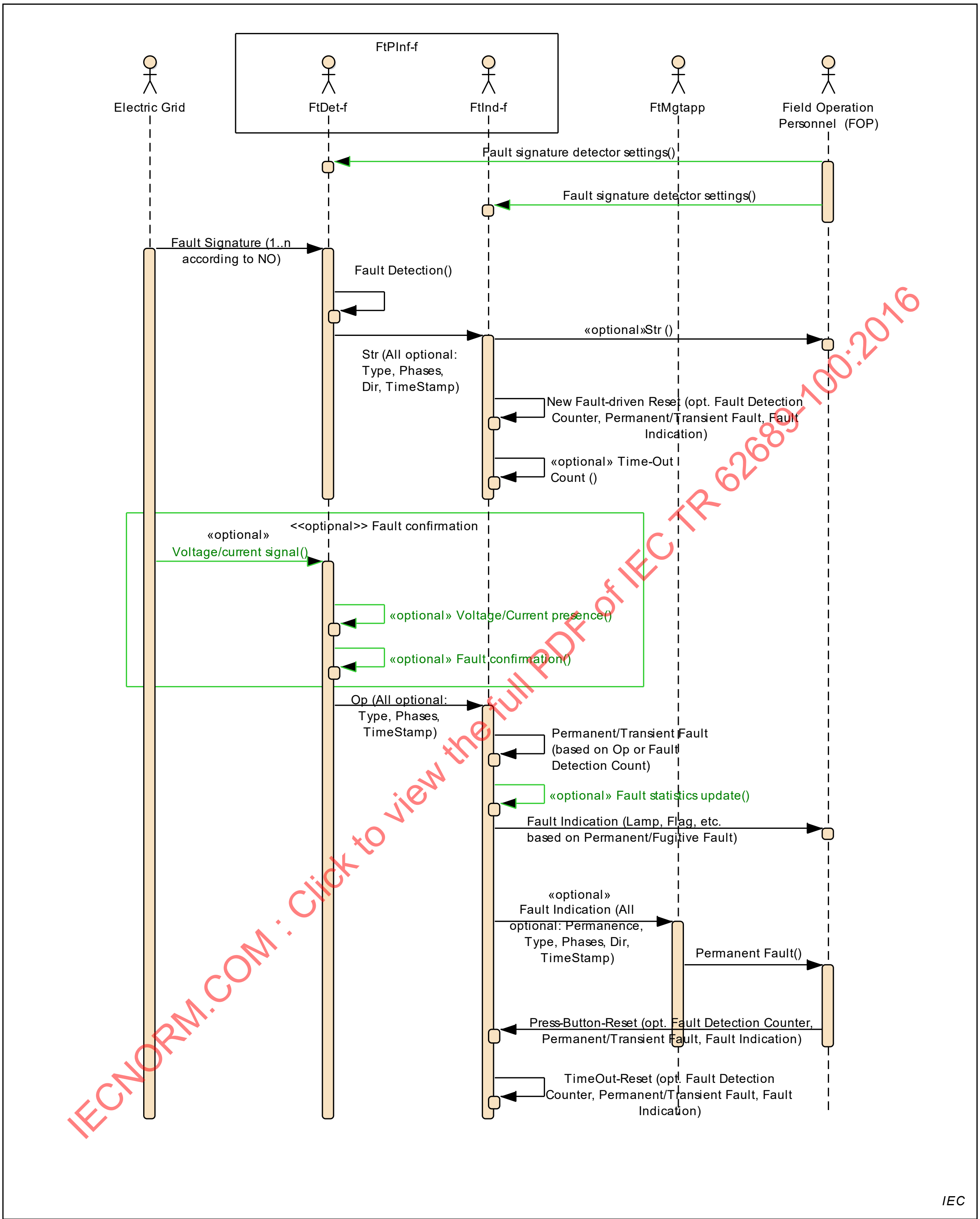


Figure 5 – Fault detection and indication – T1

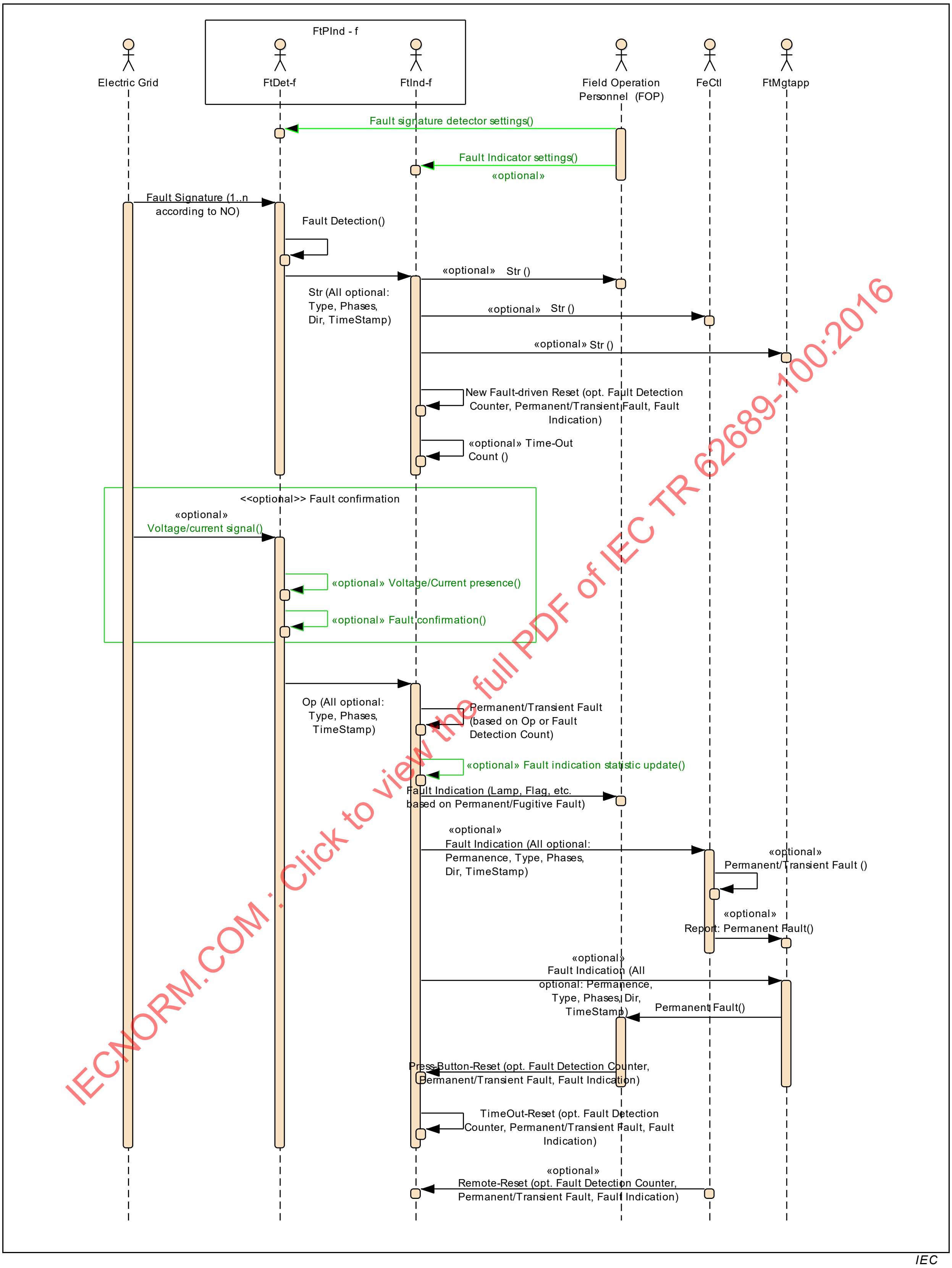
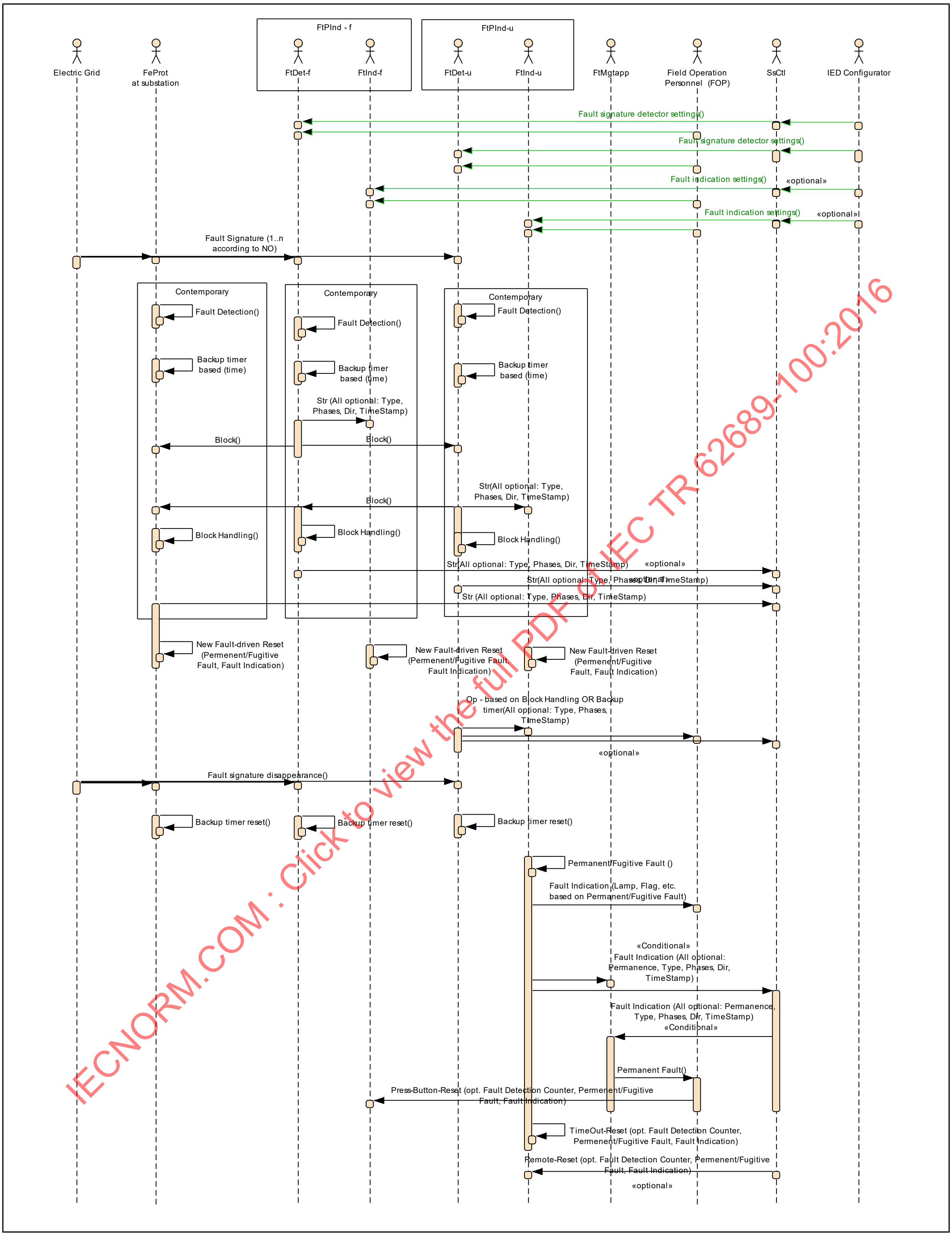


Figure 6 – Fault detection and indication– T2



IEC

Figure 7 – Fault detection and indication for FPI – T3,T4 (with communication to HV/MV SS) in the context of FLISR as described in 4.4.5

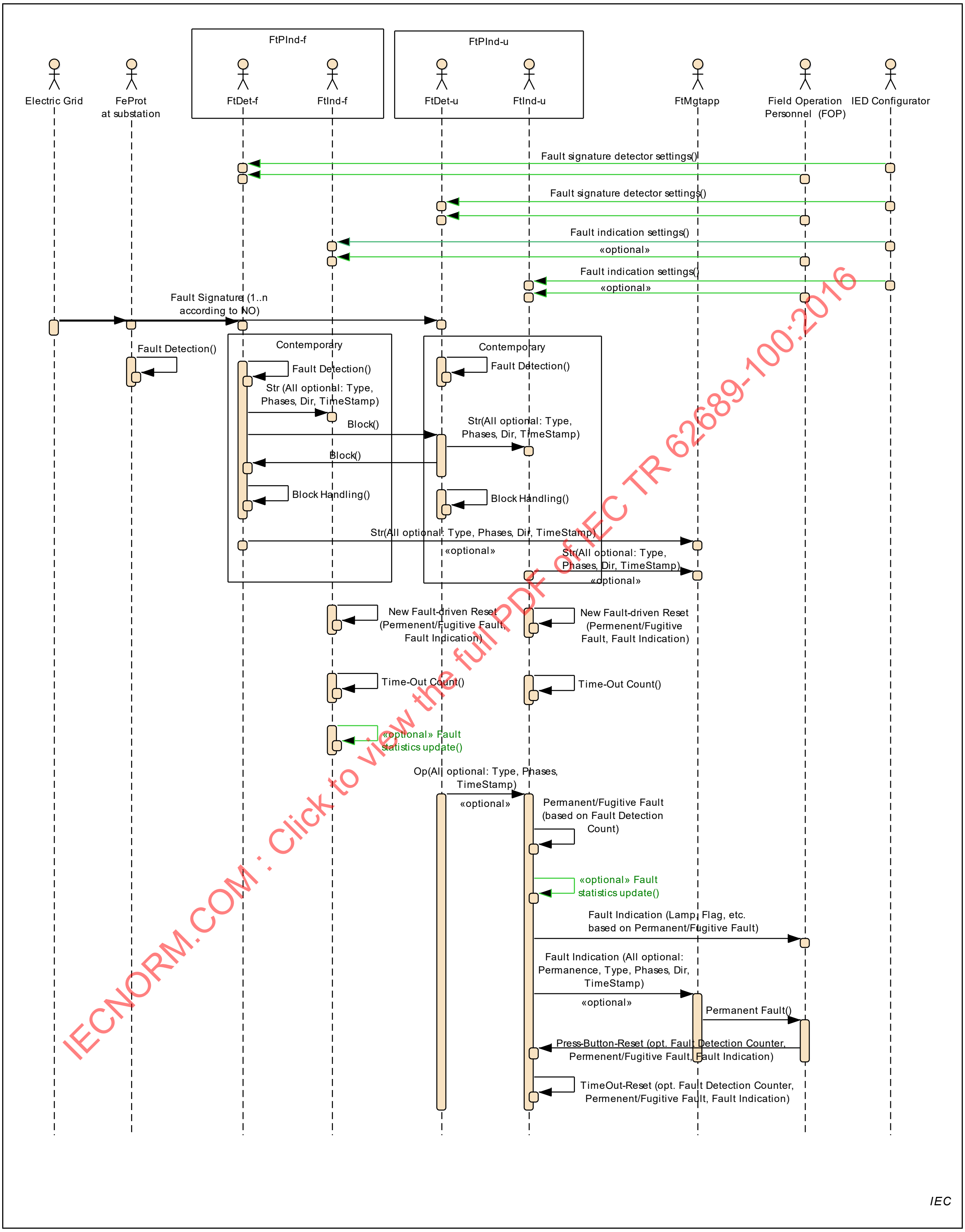


Figure 8 – Fault detection and indication for FPI – T3,T4 (without communication to HV/MV SS) in the context of FLISR as described in 4.4.5

4.3.1.3 Technical details

4.3.1.3.1 Actors: people, systems, applications, databases, the power system, and other stakeholders

Actors			
Grouping (community)		Group description	
Actor name See actor list	Actor type See actor list	Actor description See actor list	Further information
Electric Grid	System	Refer to 4.2	
FeProt at main substation	Device	Refer to 4.2	
FtPInd	Device	Refer to 4.2	
FtInd	Device	Refer to 4.2	
FtDet	Device	Refer to 4.2	
Field operation personnel (FOP)	Person	Refer to 4.2	
RTU	Device	Refer to 4.2	
DMSapp	(System) Application	Refer to 4.2	
Quality index system	(System) Application	Refer to 4.2	
FtMgtapp	(System) Application	Refer to 4.2	
Fault Location	(System) Application	Refer to 4.2	

4.3.1.3.2 Preconditions, assumptions, post condition, events

Use case conditions			
Actor/system/ information/contract	Triggering event	Pre-conditions	Assumption
DMSapp	Continuous		The Grid is continuously monitored The Grid topology is known and reflects the real topology The Grid energy path is known and reflects the real path (effective status of remote monitored and controllable switches).
Grid	Fault		The Grid is reacting in presence of the fault
FtLOCapp	Fault detection autorecloser operation		The application that performs fault indication and reporting (location) is activated by the fault detection. The application may operate autonomously using local signals or/and with the support of communication network (client-server or peer to peer). If communication is used, enough energy storage shall be available.
FeProt at main substation	Fault detection		The application that performs fault location for the indication and reporting is activated by the fault detection. The application may operate autonomously using local signals or/and with the support of communication network (client-server or peer to peer). It is assumed that enough energy storage is available.
FtPInd	Overcurrent/earth faults/over-undervoltage, etc		Backup power/battery shall be available for operation and communications.
Setting for directional detection	N.A.		These parameters are included in the protection settings

4.3.1.3.3 References / Issues

References						
No.	References type	Reference	Status	Impact on the use case	Originator / organisation	Link

4.3.1.3.4 Step by Step Analysis of the use case

Scenario conditions					
No.	Scenario name	Primary actor	Triggering event	Pre-condition	Post-condition
5.1.1.4.1	Fault Indication for FtPInd – T1	FtPInd	Fault Signature handling		The distribution system stakeholders are aware of the fault and its characteristics (type, location, etc.)
5.1.1.4.2	Fault Indication for FtPInd – T2	FtPInd	Fault Signature handling		The distribution system stakeholders are aware of the fault and its characteristics (type, location, etc.)
5.1.1.4.3	Fault Indication for FtPInd – T3,T4 (with communication to HV/MV SS)	FtPInd, HV/MV SS protection	Fault Signature handling		The distribution system stakeholders are aware of the fault and its characteristics (type, location, etc.)
5.1.1.4.4	Fault Indication for FtPInd – T3,T4 (without communication to HV/MV SS)		Fault Signature handling		The distribution system stakeholders are aware of the fault and its characteristics (type, location, etc.)

4.3.1.3.5 Steps – Fault Indication for FtPInd – T1

The details of the Str and Op information (directionality, general or per single phase and/or neuter) depends on the type of Fault Detection handling, according to 4.3.2 to 4.3.7.

Scenario								
Scenario name:		Fault indication ftpind – t1						
Step no.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , r-id**
0	equipment settings/net work maintenance	fault detection and indication settings	fault signature detection settings	file transfer or/and client/server interactions and/or proprietary interface	Field operation personnel	FtDet	Protection settings (Thersholds, curves, direction, etc.)	Optional, utility policy dependant. Could be proprietary or IEC 61850 information exchange
0a			fault signature indication settings	file transfer or/and client/server interactions and/or proprietary interface	Field operation personnel	FtInd	Parameter settings (timers, counters, etc.)	Optional, utility policy dependant. Could be proprietary or IEC 61850 information exchange
1	Fault on feeder	fault detection	fault detection		Electric Grid	FtDet	Fault Signature	Internal process (fault type analysis)
2			fault analysis		FtDet	FtInd	Protection Str	Internal process
2a			fault analysis		FtDet	Field operation personnel	Protection Str	Optional
2b			fault analysis		FtInd	Internal F. handling data initialization		
3		fault confirmation	voltage/current presence analysis		Electric Grid	FtDet	Voltage / Current signal	Optional Process
3a			voltage/current presence analysis		FtDet			Internal optional process
3b			fault confirmation		FtDet	FtInd	Protection Op	Internal process
4		fault indication	fault statistics and indication		FtInd			Internal counters update and heuristic's related to fault type
4a			fault indication		FtInd	Field operation personnel	Fault indication	Local HMI
4b			fault indication	IEC 61850 Report?	FtInd	FtMgtapp	Fault Indication	Optional

Scenario								
Scenario name:		Fault indication ftpind – t1						
Step no.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , r-id**
5			fault indication		FtMgtapp	Field operation personnel	Permanent Fault notification	
6			fault indication		Field operation personnel	FtInd	Fault Indication Reset	Optionally, the fault detection counter could be reset
7			fault indication		FtInd		Fault Indication Reset	Internal process after timeout without operator intervention Optionally, the fault detection counter could be reset

4.3.1.3.6 Steps – Fault Indication for FtPInd – T2

The details of the Str and Op information (directionality, general or per single phase and/or neuter) depends on the type of Fault Detection handling, according to 4.3.2 to 4.3.7.

Scenario								
Scenario name:		Fault indication ftpind – t2						
Step no.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , r-id**
1	equipment settings/net work maintenance	fault detection and indication settings	fault signature detection settings	file transfer or/and client/server interactions and/or proprietary interface	Field operation personnel	FtDet	Protection settings (Thersholds, curves, direction, etc.)	Optional, utility policy dependant. Could be proprietary or IEC 61850 information exchange
1a			fault signature indication settings	file transfer or/and client/server interactions and/or proprietary interface	Field operation personnel	FtInd	Parameter settings (timers, counters, etc.)	Optional, utility policy dependant. Could be proprietary or IEC 61850 information

Scenario								
Scenario name:		Fault indication ftpind – t2						
Step no.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , r-id**
								exchange
2	fault on feeder	fault detection	fault detection		Electric Grid	FtDet	Fault signature	Internal process (fault type analysis)
3			fault analysis		FtDet	FtInd	Protection Str	Internal process
3a			fault analysis		FtDet	Field operation personnel	Protection Str	Optional
3b			fault analysis		FtInd	Internal F. handling data initialization		
4		fault confirmation	voltage/current presence analysis		Electric Grid	FtDet	Voltage / current signal	Optional process
4a			voltage/current presence analysis		FtDet			Internal optional process
4b			fault confirmation		FtDet	FtInd	Protection Op	Internal process
5		fault indication	fault statistics and indication		FtInd			Internal counters update and heuristic's related to fault type
5a			fault indication		FtInd	Field operation personnel	Fault indication	Local HMI
5b		fault reporting	fault reporting	IEC 61850 Report?	FtInd	Substation RTU	Fault indication	Optional
5c			fault reporting		Substation RTU	FtMgtapp	Fault type report	Optional Internal process (fault type analysis)
5d			fault reporting		Substation RTU	Quality index system	Fault type report	Optional Internal process (fault type analysis)
6		fault indication	fault indication		FtInd	FtMgtapp	Fault indication	Optional
6a			fault indication		FtInd	Quality index	Fault indication	Optional

Scenario								
Scenario name:		Fault indication ftpind – t2						
Step no.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , r-id**
						system		
7			fault indication		FtMgtapp	Field operation personnel	Permanent fault notification	
8			fault indication		Field operation personnel	FtInd	Fault indication reset	Optionally, the fault detection counter could be reset
9			fault indication		FtInd		Fault indication reset	Internal process after timeout without operator intervention Optionally, the fault detection counter could be reset
10			fault indication	IEC 61850 Client/Server Set	Substation RTU	FtInd	Fault Indication Reset	Optionally, the fault detection counter could be reset

4.3.1.3.7 Steps – Fault Indication for FtPInd T3,T4 feeders radially operated (with communication to HV/MV SS)

The details of the Str and Op information (directionality, general or per single phase and/or neuter) depends on the type of Fault Detection handling, according to 4.3.2 to 4.3.7.

Scenario								
Scenario name:		Fault indication FtPInd – T3,T4 (with communication to HV/MV SS)						
Step no.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , r-id**
1a	Equipment settings/ Network maintenance	fault detection and indication settings	fault signature detection settings	file transfer or/and client/server interactions and/or proprietary interface	FieldComp config tool via Substation RTU and/or Field operation personnel	FtDet-u	Protection settings (Thersholds, curves, etc.)	Optional, Utility Policy dependant. Could be proprietary or IEC 61850 information exchange Same info as for FtDet -f

Scenario								
Scenario name:		Fault indication FtPInd – T3,T4 (with communication to HV/MV SS)						
Step no.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , r-id**
2a			fault signature indication settings	file transfer or/and client/server interactions and/or proprietary interface	FieldComp config tool via Substation RTU and/or Field operation personnel	FtInd-u	Parameter settings (timers, counters, etc.)	Optional, Utility Policy dependant. Could be proprietary or IEC 61850 information exchange Same info as for FtInd -f
1b			fault signature detection settings	file transfer or/and client/server interactions and/or proprietary interface	FieldComp config tool via Substation RTU and/or Field operation personnel	FtDet-f	Protection settings (Thersholds, curves, etc.)	Optional, Utility Policy dependant. Could be proprietary or IEC 61850 information exchange Same info as for FtDet -u
2b			fault signature indication settings	file transfer or/and client/server interactions and/or proprietary interface	FieldComp config tool via Substation RTU and/or Field operation personnel	FtInd-f	Parameter settings (timers, counters, etc.)	Optional, Utility Policy dependant. Could be proprietary or IEC 61850 information exchange Same info as for FtInd -u
3a	fault on feeder	fault detection	fault detection		Electric Grid	FeProt at main substation	fault signature	Internal process (fault type analysis and any action backup handling)
3b			fault detection		Electric Grid	FtDet-u	fault signature	Internal process (fault type analysis and any action backup handling)
3c			fault detection		Electric Grid	FtDet-f	fault signature	Internal process (fault type analysis and any action backup handling)
4a			fault analysis		FtDet-u	FtInd-u	Protection Str	Internal process
5a		logical selectivity	blocking of upstream fpi/protections	GOOSE	FtDet-u	Other FtDet-u	Block	Relevant for UPSTREAM IEDs only (handling the received blocks). Only the unique unblocked IED will handle the Fault
4b		fault detection	fault analysis		FtDet-f	FtInd-f	Protection Str	Internal process

Scenario								
Scenario name:		Fault indication FtPInd – T3,T4 (with communication to HV/MV SS)						
Step no.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , r-id**
5b		logical selectivity	blocking of upstream fpi/protections	GOOSE	FtDet-f	FtDet-u	Block	Relevant for UPSTREAM IEDs only (handling the received blocks). Only the unique unblocked IED will handle the Fault
6a		fault reporting	fault analysis	IEC 61850 Report?	FeProt at main substation	Substation RTU	Protection Str	Optional
6b			fault analysis	IEC 61850 Report?	FtDet-u	Substation RTU	Protection Str	Optional
6c			fault analysis	IEC 61850 Report?	FtDet-f	Substation RTU	Protection Str	Optional
7a		fault indication	fault indication		FeProt at main substation			Internal counters update and heuristics related to fault type
7b			fault indication		FtInd-u			Internal counters update and heuristics related to fault type
7c			fault indication		FtInd-f			Internal counters update and heuristics related to fault type
8a			fault confirmation		FtDet-f	FtInd-f	Protection Op	Internal process
8b			fault indication		FtInd-f	Field operation personnel	Protection Op	Local HMI
8c			fault confirmation	IEC 61850 Report?	FtDet-f	Substation RTU	Protection Op	Optional
9a	fault on feeder disappears	fault detection	fault detection		Electric Grid	HV/MV SS Protection	Fault Signature Disappearance	Internal process (any action backup handling reset)
9b			fault detection		Electric Grid	FtDet-u	Fault Signature Disappearance	Internal process (any action backup handling reset)
9c			fault detection		Electric Grid	FtDet-f	Fault Signature Disappearance	Internal process (any action backup handling reset)
10a		fault indication	fault indication		FtInd-f	Field operation personnel	Permanent Fault Indication	Including local HMI

Scenario								
Scenario name:		Fault indication FtPInd – T3,T4 (with communication to HV/MV SS)						
Step no.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , r-id**
10b			fault indication		FtInd-f	Substation RTU	Permanent Fault Indication	Conditional: at least one between 9b or (9c+10)
10c		fault reporting	fault indication		FtInd-f	FtMgtapp	Permanent Fault Indication	Conditional: at least one between 9b or (9c+10)
10d			fault indication		FtInd-f	Quality index system	Permanent Fault Indication	Conditional: at least one between 9b or (9c+10)
11			fault analysis		Substation RTU	FtMgtapp	Permanent Fault notification	Conditional: at least one between 9b or (9c+10)
12		fault indication	fault indication		FtMgtapp	Field operation personnel	Permanent Fault notification	
13			fault indication		Field operation personnel	FtInd	Fault Indication Reset	“Press-Button”. Optionally, the fault detection counter could be reset
14			fault indication		FtInd		Fault Indication Reset	Internal process after timeout without operator intervention Optionally, the fault detection counter could be reset
15			fault indication	IEC 61850 Client/Server Set	Substation RTU	FtInd	Fault Indication Reset	Optionally, the fault detection counter could be reset

4.3.1.3.8 Steps – Fault indication for FPI T3,T4 feeders radially operated (without communication to HV/MV SS)

The details of the Str and Op information (directionality, general or per single phase and/or neuter) depends on the type of Fault Detection handling, according to according to 4.3.2 to 4.3.7.

Scenario								
Scenario name:		Fault Indication FPI – T3,T4 (without communication to HV/MV SS)						
Step no.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , r-id**
1a	equipment settings/network maintenance	fault detection and indication settings	fault signature detection settings	file transfer or/and client/server interactions and/or proprietary interface	FieldComp config tool and/or Field operation personnel	FtDet-u	Protection settings (Thersholds, curves, etc.)	Optional, Utility policy dependant. Could be proprietary or IEC 61850 information exchange Same info as for FtDet -f
2a			fault signature indication settings	file transfer or/and client/server interactions and/or proprietary interface	FieldComp config tool and/or Field operation personnel	FtInd-u	Parameter settings (timers, counters, etc.)	Optional, utility policy dependant. Could be proprietary or IEC 61850 information exchange Same info as for FtInd -f
1b			fault signature detection settings	file transfer or/and client/server interactions and/or proprietary interface	FieldComp config tool and/or Field operation personnel	FtDet-f	Protection settings (Thersholds, curves, etc.)	Optional, utility policy dependant. Could be proprietary or IEC 61850 information exchange Same info as for FtDet -u
2b			fault signature indication settings	File Transfer or/and Client/Server interactions and/or proprietary interface	FieldComp config tool and/or Field operation personnel	FtInd-f	Parameter settings (timers, counters, etc.)	Optional, utility policy dependant. Could be proprietary or IEC 61850 information exchange Same info as for FtInd -u
3a	fault on feeder	fault detection	fault detection		Electric Grid	FeProt at ain substation	Fault Signature	Internal process (fault type analysis)
3b			fault detection		Electric Grid	FtDet-u	Fault Signature	Internal process (fault type analysis)
3c			fault detection		Electric Grid	FtDet-f	Fault Signature	Internal process (fault type analysis)
4a			fault analysis		FtDet-u	FtInd-u	Protection Str	Internal process
5a		logical selectivity	blocking of upstream fpi/protections	GOOSE	FtDet-u	Other FtDet-u	Block	Relevant for UPSTREAM IEDs only (handling the received blocks). Only the unique unblocked IED will handle the Fault
4b		fault detection	fault analysis		FtDet-f	FtInd-f	Protection Str	Internal process

Scenario								
Scenario name:		Fault Indication FPI – T3,T4 (without communication to HV/MV SS)						
Step no.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , r-id**
5b		logical selectivity	blocking of upstream fpi/protections	GOOSE	FtDet-f	FtDet-u	Block	Relevant for UPSTREAM IEDs only (handling the received blocks). Only the unique unblocked IED will handle the Fault
6a		fault reporting	fault analysis	IEC 61850 Report?	FtDet-u	Substation RTU	Protection Str	Optional
6b			fault analysis	IEC 61850 Report?	FtDet-f	Substation RTU	Protection Str	Optional
7a		fault indication	fault indication		FtInd-u			Internal counters update and heuristics related to fault type
7b			fault indication		FtInd-f			Internal counters update and heuristics related to fault type
8			fault confirmation		FtDet-f	FtInd-f	Protection Op	Optional Internal process
9a		fault indication	fault indication		FtInd-f	Field operation personnel	permanent fault indication	Including local HMI
9b			fault indication		FtInd-f	FtMgtapp	permanent fault indicatication	Optional
10			fault indication		FtMgtapp	Field operation personnel	permanent fault notification	
11			fault indication		Field operation personnel	FtInd	fault indication reset	"Press-Button". Optionally, the fault detection counter could be reset
12			fault indication		FtInd		fault indication reset	Internal process after timeout without operator intervention Optionally, the fault detection counter could be reset

4.3.1.4 Information Exchanged

Information exchanged		
Name of information exchanged	**Description of information exchanged**	**Requirements to information data** **R-id**
Str	Protection dependant (directionality, general or per single phase and/or neuter, etc.)	Only if new DO/DA or new P-Type LN
Op	Protection dependant (general or per single phase and/or neuter, etc.)	Only if new DO/DA or new P-Type LN
Fault indication	Fault presence with type of fault, impacted phase, time tagging, and fault direction (possibly)	New LN
Fault statistical details	Counters per fault type per given time periods.	New LN
Voltage presence/absence	Status and settings	New LN
Current presence/absence	Status and settings	New LN
Protection settings	Thersholds, timers, curves, etc.	Only if new DO/DA or new P-Type LN
Fault indicator parameter settings	Timers, counters, etc.	New LN
Fault indication reset	Remote fault indication reset (counters, etc)	New LN
Block	Status of block request and topological information for logical selectivity execution	New DO/DA or new LN
Foreward/backward direction convention setting	(Possibly) set the expected relationship between the direction of the current and the notions of backward/foreward. Usually the closest busbar is the reference, but this may be an issue in case of contiguous line sections	Such setting shall affect in the same way all P-Type nodes invlved in the fault signature detection

NOTE In IEC 62689-1, the term "Fault detection" is used instead of "Fault detection and indication".

4.3.2 Overcurrent non directional Fault Localization and Indication (F1C/NC)

4.3.2.1 General

This use case is relevant to the overcurrent non directional fault localization and indication (phase to earth fault on solid earthed systems) with or without confirmation (ref. IEC 62689-1, F1C/NC…). It relies on the generic one described in 4.3.1, and has the following specificities.

4.3.2.2 F1(C/NC) for T1 and T2 application

4.3.2.2.1 Fault Detection

To detect the phase to earth fault on solid earthed systems, it is required an overcurrent function and, if necessary, a confirmation based on voltage presence/absence or current absence. For communication and data exchange purposes, IEC 61850-7-4 already foresees the following LNs which DOs and DAs are sufficient for the purpose: PTOC, PTUC, PTUV, PTOV.

The confirmation may be based on:

- **Voltage presence/absence –** in this case PTUV and PTOV LNs shall be used to indicate a 2 values information (Vprs) which calculation is based on the following criteria:
  – the voltage presence is determined when at least on one phase the relevant PTOV operates (StrVal = Vp and OpDlTmms=Tp are reached)

– the voltage absence is determined when on all phases the relevant PTUVs operate (StrVal = Va and OpDlTmms=Ta are reached).

The specific semantic of the Vprs requires a **new LN** (please refer to Clause 5).

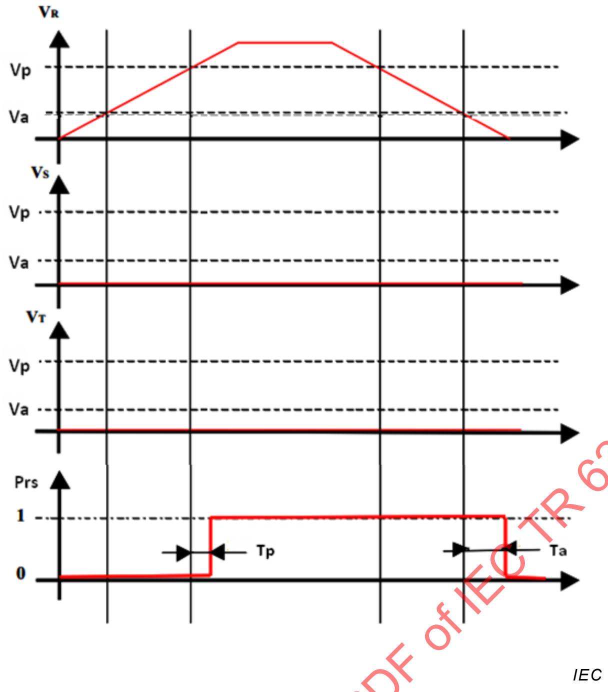


Figure 9 – Voltage presence/absence

- **Current presence/absence –** in this case PTOC and PTUC LNs shall be used to indicate a 2 values information (Cprs) which calculation is based on the following criteria (similar to the Vprs evaluation):
  – the current presence is determined when at least on one phase the relevant PTOC operates
  – the current absence is determined when on all phases the relevant PTUCs operate.

  The specific semantic of the Cprs requires a **new LN** (please refer to Clause 5).

4.3.2.2.2 Fault indication

To indicate a phase to earth fault on solid earthed systems, it is required to communicate the following information:

- (opt.) the Str DO of the PTOC LN, detailing optionally the relevant phase and the Time Stamp
- the Indication of the event to the Field operation personnel and (opt.) to Outage Management System for T1 and T2 and (opt.) to the MV/LV SS RTU for T2.

The specific semantic of the Fault indication requires a **new LN** including all the related parameters (please refer to Clause 5).

4.3.3 Phase to earth faults, non directional fault detection (F2)

This use cases relies on the generic one described in 4.3.1, but fault signature detection is assumed to be capable of detecting phase to earth faults, non directional faults.

4.3.4 Overcurrent and phase to earth non directional faults detection (F3)

This case is just the concatenation of the two previous one (F1 + F2).

4.3.5 Overcurrent, directional and non directional, fault detection (F4)

This use cases relies on the generic one described in 4.3.1, but fault signature detection is assumed to be capable of detecting overcurrents, directional and non directional, faults. It will request to handle directionality of fault in the information exchange.

4.3.6 Overcurrent, non directional, phase to earth faults, directional and non directional fault detection (F5)

This use cases relies on the generic one described in 4.3.1, but fault signature detection is assumed to be capable of detecting overcurrents, non directional, phase to earth faults, directional and non directional faults. It will request to handle directionality of fault in the information exchange.

4.3.7 Overcurrents and phase to earth faults, directional and non directional fault detection (F6)

This case is just the concatenation of the two previous one (F4 + F5).

4.4 Use cases related to “other functions”

4.4.1 Report on device health

Not developped yet

4.4.2 Monitor substation environment

Not developped yet

4.4.3 Monitor external communication

Not developped yet

4.4.4 Monitor energy flow (energy flow related use cases)

4.4.4.1 Use case breakdown

Use case related to the parent use cases were broken down in sub use cases as presented below in Figure 10.

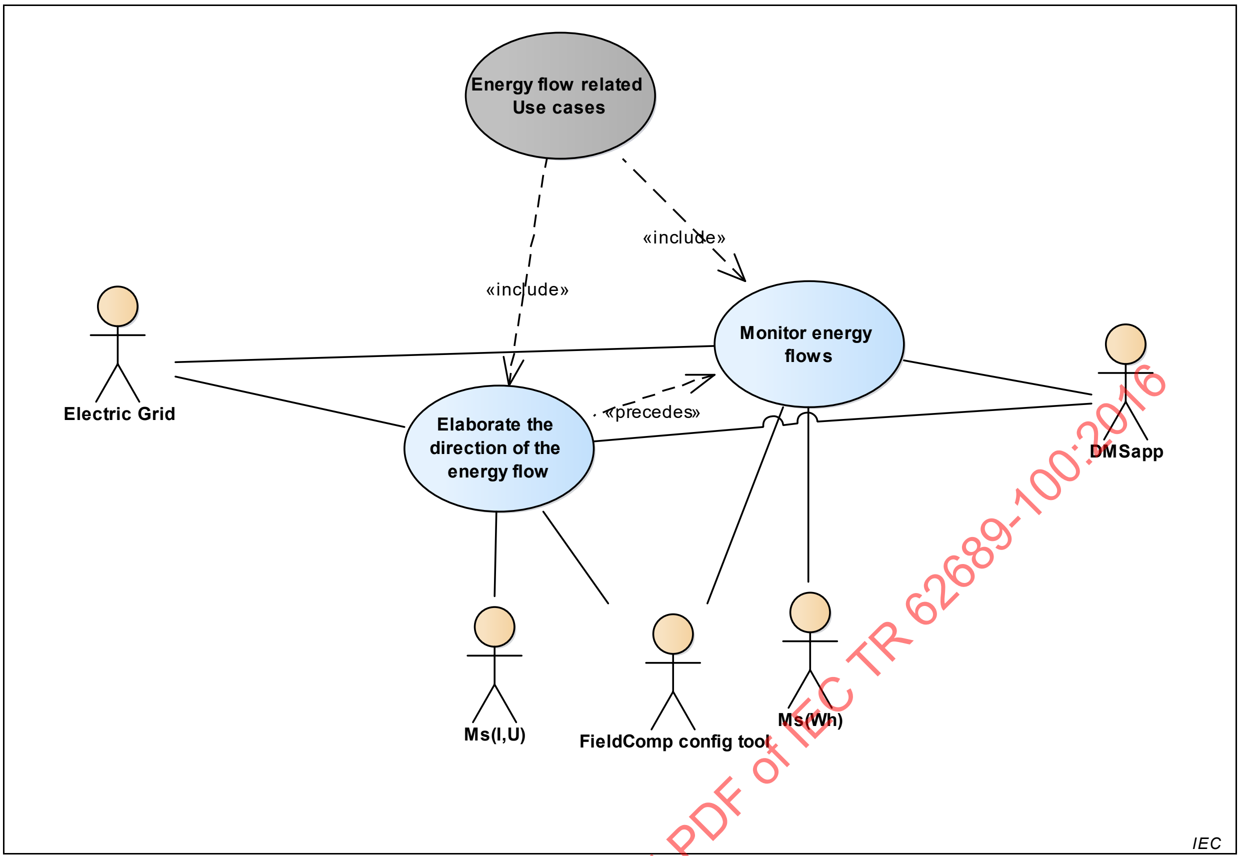


Figure 10 – Energy flow related use cases

Figure 11 shows a generic sequence diagram which covers both sub use cases.

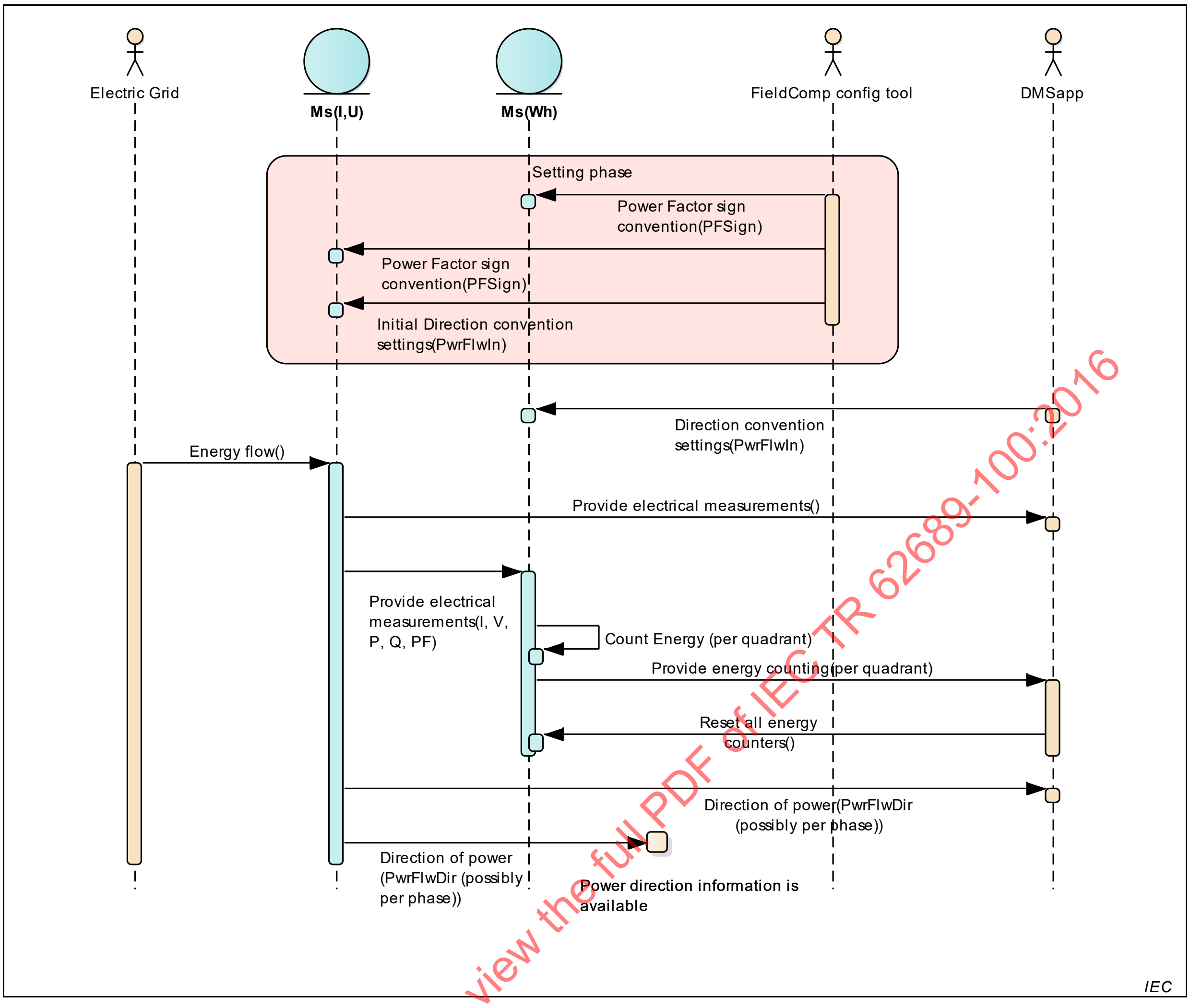


Figure 11 – Sequence diagram for monitoring energy flows use cases

4.4.4.2 Monitor energy flows

4.4.4.2.1 Description of the use case

4.4.4.2.1.1 General

At current time, the main use case considered for energy measurement is for billing metering purpose, expecting the count of a number of pulses, each pulse representing a quantity of energy. The purpose of this use case is for operation, to provide all needed information relating to active, reactive and net energy, supplied/delivered or demanded/received, or even per quadrant (Q1 to Q4).

4.4.4.2.1.2 Name of the use case

Use case identification		
Id	**Domain(s)**	**Name of the use case**
	Distribution automation	Monitor energy flows

4.4.4.2.1.3 Version management

Version management						
Version management changes / version	Date	Name author(s) or committee	Domain expert	Area of expertise / domain / role	Title	Approval status
First version		JAHWG51				Draft

4.4.4.2.1.4 Scope and objectives of the use case

Scope and objectives of the use case	
Scope	Monitor energy flows for operation purpose.
Objective	Enable to measure energy active, reactive and net power, supplied/delivered toor demanded/received out, or even per quadrant (Q1 to Q4) at the point of measurement, for operation purpose.

4.4.4.2.1.5 Narrative of the use case

Narrative of the use case
Short description
Provides detailed active or reactive or net cumulated energy either per quadrant, or globally delivered or received at the point of measurement, based on the energy flows direction conventions.
Complete description
Provides detailed active or reactive or net cumulated energy globally for the 3 phases or per phases. Provides energy metering per quadrant, or delivered or received (based on forward/backward convention) at the point of measurement. The calculation context (period duration & automatic reset, max, min,…) is set prior to the calculation. All energy counters are resettable synchronously.

4.4.4.2.2 Diagrams of the use case

Diagram(s) of the use case
Refer to Figure 10

4.4.4.2.3 Technical details

4.4.4.3 Elaborate the direction of the energy flow

4.4.4.3.1 Description of the use case

4.4.4.3.1.1 General

Host/spread the convention (setting type) which allows other functions to define the "normal energy flow" and then whether a measured energy is supplied/delivered downstream or demanded/received out of downstream.

This setting will be used further either for protection direction information or for counting cumulated energy based on its direction. It also elaborates dynamically a tag indicating both for active and reactive power the direction of the energy flow (forward or backward).

4.4.4.3.1.2 Name of the use case

Use case identification		
Id	**Domain(s)**	**Name of the use case**
	Distribution automation	Elaborate the direction of the energy flow

4.4.4.3.1.3 Version management

Version management						
Version management changes / version	**Date**	**Name author(s) or committee**	**Domain expert**	**Area of expertise / domain / role**	**Title**	**Approval status**
First version	19/3/2015	JAHWG 51				Draft

4.4.4.3.1.4 Scope and objectives of the use case

Scope and objectives of the use case	
Scope	Elaborate the direction of energy flows.
Objective	Allows other functions (such as protection or energy measurement) to define whether the energy is supplied/delivered to or demanded/received out.

4.4.4.3.1.5 Narrative of the use case

Narrative of the use case
Short description
Based on given conventions, elaborate the direction of power flows.
Complete description
Based on given conventions on Power factor sign and Direction convention, elaborate the direction of active and reactive power.

4.4.4.3.2 Diagrams of the use case

Diagram(s) of the use case
Refer to Figure 11

4.4.4.4 Technical details

4.4.4.4.1 Actors: people, systems, applications, databases, the power system, and other stakeholders

Actors			
Actor name	**Actor type**	**Actor description**	**Further information**
Electric Grid	System	Refer to 4.2.	
DMSapp	System	Refer to 4.2	
FieldComp config tool	(System) Application	Refer to 4.2	
Ms(I,U)	(Device) Function	Refer to 4.2	
Ms(Wh)	(Device) Function	Refer to 4.2	
Ms(power flow direction)	(Device) Function	Refer to 4.2	

4.4.4.4.2 Steps – Elaborate the direction of the energy flow

Scenario								
Scenario Name:		Elaborate the direction of the energy flow						
Step no.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , r-id**
1a	Equip settings/Network maintenance	setting phase	power factor sign setting	parameter setting	FieldComp config tool	Ms(I,U)	PFSign	
1b	Equip settings/Network maintenance	setting phase	definition of the “supply/demand convention”	parameter setting	FieldComp config tool	Ms(Wh)	RvPwrFlwSgn	
2	Topology change	setting update phase	(optional)re-definition of the “supply/demand convention”	parameter setting	DMSapp	Ms(I,U)	RvPwrFlwSgn	
3	Continuous	running	electrical measurement”	real-time measurement	Ms(I,U)	Ms(power flow direction)	Per phase signed P, Q, PF. Powerflow direction (foreward – from supply or backward – to supply)	
4	Continuous	running	electrical measurement”	per quadrant energy counting	Ms(Wh)	Ms(power flow direction)	Per quadrant Wh, VArh, VAh. Real, reactive and apparent suplied energy, or demand energy, or difference or addition of both	

4.4.4.4.3 Information exchanged

Information exchanged		
Name of information exchanged	**Description of information exchanged**	**Requirements to information data** **R-id**
PFSign	Power factor sign – needed to cope with different convention all around the world. This settings guarantee that all concerned functions work with the same convention, typically IEC based or IEEE based	See PFSign as designed in MMXU of IEC 61850-7-4, however it shall be located at a place where it will affect all measurements and associated functions the same way. Existing DO in new LN
PwrFlwIn	Enable the definition of the “supply/demand convention”. It may affect simultaneously multiple functions	New DO in new LN. Must be aligned with CIM convention
I,U, P, Q, PF	Per phase signed.	Existing MMXU
PwrFlwDir	Powerflow direction (from supply or to supply), including per phase	New DO
Ms(I,U)	Per phase signed P, Q, PF. Powerflow direction (foreward – from supply or backward – to supply)	Existing DOs New DOs
Ms(Wh)	(3 phase or single phase) per quadrant Wh, VArh, VAh. Real, reactive and apparent suplied energy, or demand energy, or difference or addition of both	New DOs

4.4.5 Contribute to distributed automatic FLISR

4.4.5.1 Description of the use case

4.4.5.1.1 Name of the use case

Use case identification		
ID	**Domain(s)**	**Name of the use case**
	Distribution automation	Fault localization and isolation (with related info reporting) in a feeder radially operated, built with distributed protection breaker capabilities

4.4.5.1.2 Version management

Version management						
Version management changes / version	**Date**	**Name author(s) or committee**	**Domain expert**	**Area of expertise / domain / role**	**Title**	**Approval status**
First version in IEC template		JAHWG51				Draft

4.4.5.1.3 Scope and objectives of the use case

Scope and objectives of the use case	
Related business case	Distribution system operation
Scope	The fault location and isolation operates in automated mode to help the distribution system operator isolate faults and reconfigure the network to re-energize as many unaffected feeder sections as possible.
Objective	Isolate faults in the power system to maintain safety and minimize the duration of power interruptions to improve overall power grid reliability.

4.4.5.1.4 Narrative of the use case

Narrative of the use case
Short description
The main purpose of this use case is, by the usage of breakers along the feeder and telecommunication, to not only ensure the automatic isolation of earth faults, but also to prevent as well unwanted islanding conditions. The Transfer Trip without fault has not been considered in this document. If required, a new clause will be added accordingly. For a better comprehension, the complete use case has been spilt in three different sub-cases, according to the fault location: Fault along MV feeder (Figure 12) Fault inside End User's plant (Figure 13) Fault along MV feeder with presence of DER and consequent need of transfer trip to avoid possible uncontrolled islanding (Figure 14)
Complete description
Fault located along MV feeder (Figure 12): All FtPInds usptream from the fault location detect the fault, as well as the protection device in the HV/MV substation. Without the faul, a broadcast and repeated Goose message is sent periodically from every FtPInd to all the other ones. After the fault occurrence, all the FtPInds upstream from the fault change the message payload indicating the fault detection. This information acts as a block for every FtPInd receiving it (being a broadcast signal, all the FtPInds receive this signal, but only those ones usptream from the closest to the fault will subscribe it, while all the FtPInds dowstream from the closest (upstream) from the fault will ignore the signal with different payload). Therefore, only the FtPInd closest (uspream) to the fault may act (it does not receive any blocking signal contemporaneously to the fault detection). A further refinement has been added in order to • consider possibly time-based backup protection (chronologic selectivity), and • consider the case where the feeder is equiped of both breakers and sectionalisers along the feeder. In that case, a second process will happen, when de-energised, to used the sectionaliser to isolate the faulty section

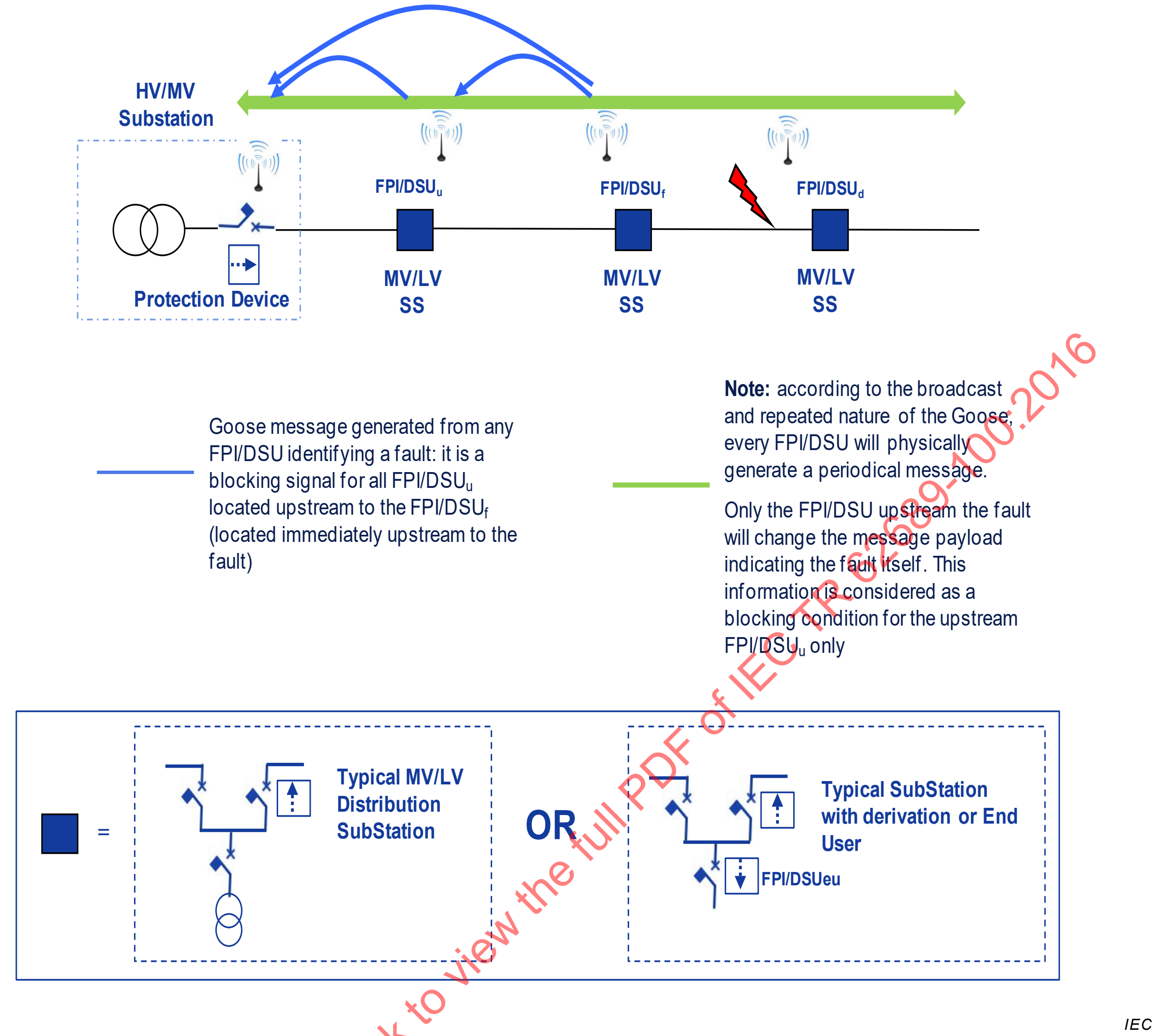


Figure 12 – Logical selectivity – FLI along the MV feeder

Fault located inside the End user plant (Figure 13):

All FtPInds along MV feeder behaves like in the previous situation.

In this case, the FtPInd closest (usptream) to the fault cannot act because it receives the blocking signal from the End user general protection.

All protections inside the End user plant are enabled to communicate only with the $FtPInd_{eu}$ on a local TLC network managed from the $FtPInd_{eu}$. GOOSE message with different paylod, used as blocking signals, are always subscribed from $FtPInd_{eu}$, being confined in the local network.

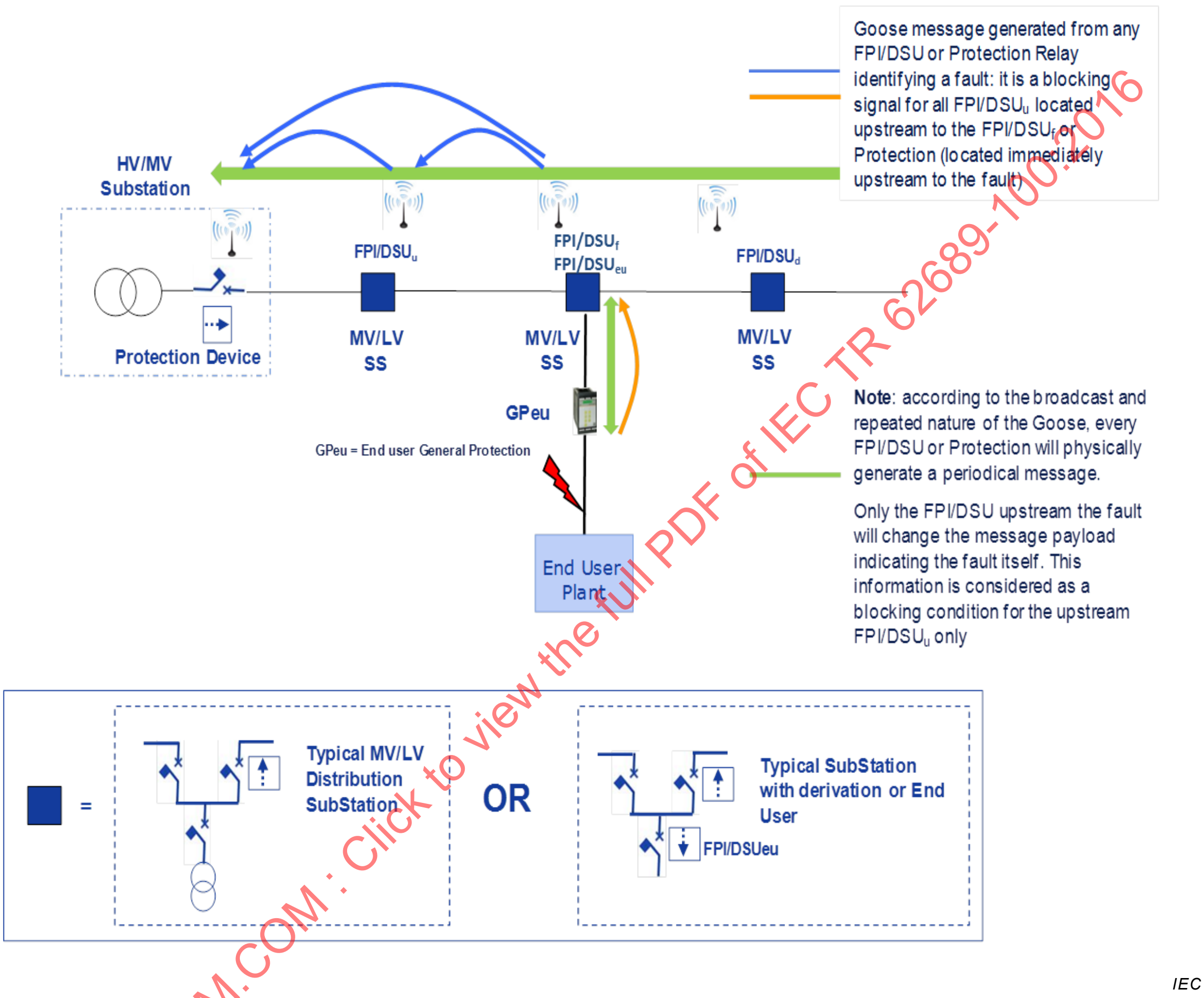


Figure 13 – Logical selectivity – FLI inside the EU plant

Fault along MV feeder with presence of DER and consequent need of transfer trip to avoid possible incontrolled islanding (Figure 14):
All FtPInds behave as in the first situation.
In addition, the FtPInd closest (usptream) to the fault, the only one enabled to act, send a Goose message to all $FtPInd_{eu}$ downstream from it after the completion of its action.
All protections inside the end user plant are enabled to communicate only with the $FtPInd_{eu}$ on a local TLC network managed from the $FtPInd_{eu}$.

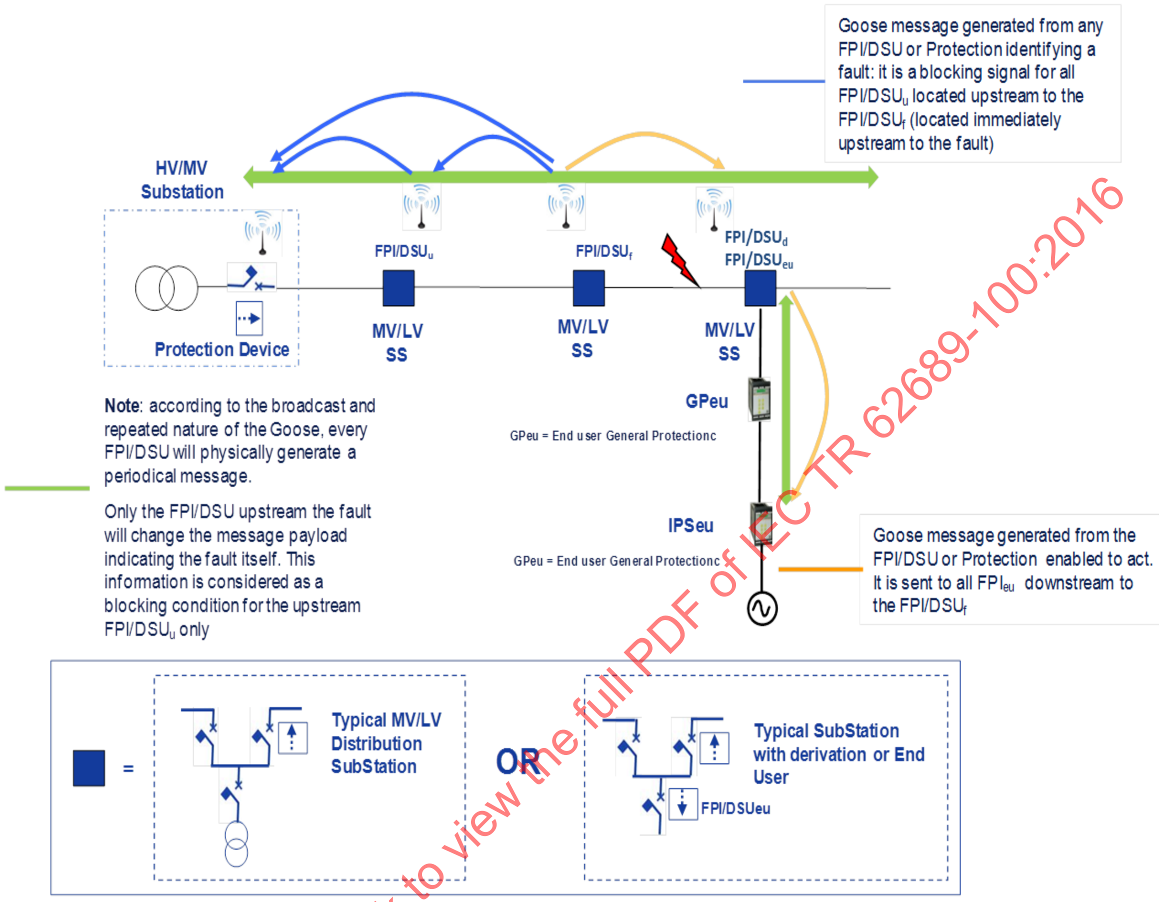


Figure 14 – Logical selectivity – FLI along the MV feeder and anti-islanding

4.4.5.2 Diagrams of the use case

4.4.5.2.1 Main diagram

Figure 15 shows the main diagram of use cases related to Fault location and isolation.

Diagram(s) of the use case – main diagram

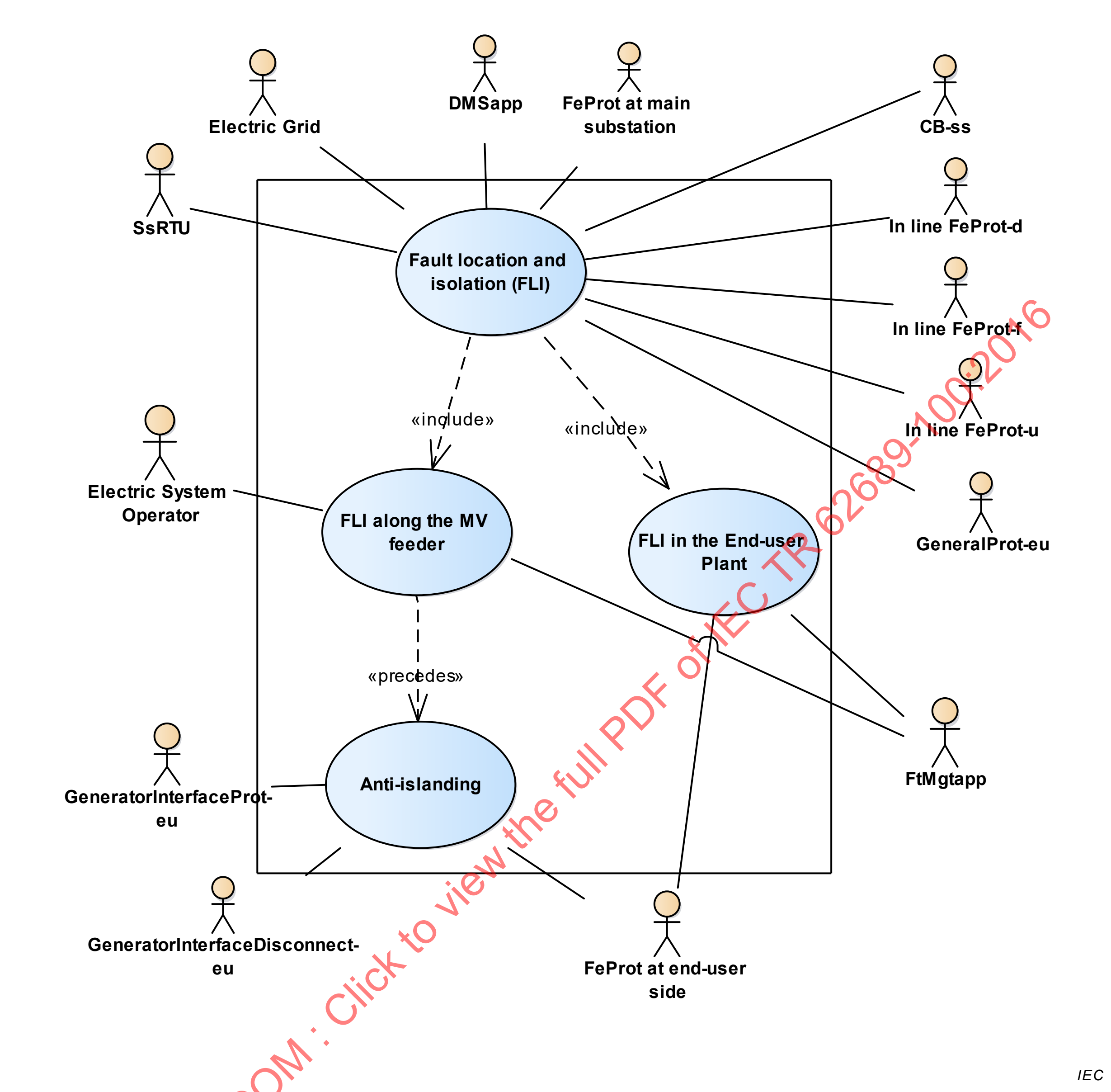
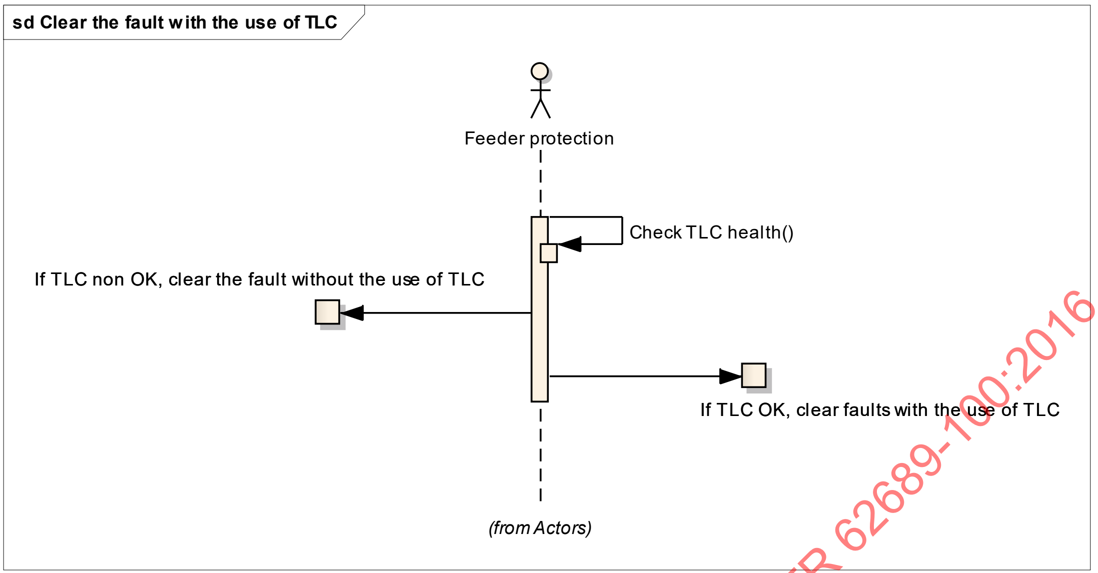


Figure 15 – Use case – fault location indication

4.4.5.2.2 Clear the fault with or without the use of TLC

Figure 16 shows the typical sequence diagram for handling the health of TLC.

Diagram(s) of the use case – Clear the fault with or without the use of TLC



IEC

Figure 16 – For further analysis

4.4.5.3 Technical details

4.4.5.3.1 Actors: people, systems, applications, databases, the power system, and other stakeholders

Actors			
Actor name	**Actor type**	**Actor description**	**Further information**
In line feeder protection (In line FeProt)	Device	Refer to 4.2	An index can be added for distinguishing different instances of actor
GeneralProt-eu	Device	Refer to 4.2	
GeneralProt-eu	Device	Refer to 4.2	
GeneratorInterfaceDisconnect-eu	Device	Refer to 4.2	
Grid	System	Refer to 4.2	
FeProt at main substation	Device	Refer to 4.2	
FtPInd	Device	Refer to 4.2	An index can be added for distinguishing different instances of actor
In line FeProt-u	Device	A feeder protection equipement (FeProt – Refer to 4.2.) located upstream to a fault, but not the closest one – see 4.2	An index can be added for distinguishing different instances of actor
In line FeProt-f	Device	A feeder protection equipment (FeProt – Refer to 4.2.) located upstream the closest to a fault – see 4.2	An index can be added for distinguishing different instances of actor
In line FeProt-d	Device	A feeder protection equipement (FeProt – Refer to 4.2.) located	An index can be added for

Actors			
Actor name	**Actor type**	**Actor description**	**Further information**
		downstream to a fault – see 4.2	distinguishing different instances of actor
GeneralProt-eu	Person	Refer to 4.2	
Field operation personnel (FOP)	Person	Refer to 4.2	
RTU	Device	Refer to 4.2	
DMSapp	System	Refer to 4.2	
FtMgtapp	System	Refer to 4.2	
FLISRapp	Application	Refer to 4.2	

4.4.5.3.2 Preconditions, assumptions, post condition, events

Use case conditions			
Actor/system/information/contract	**Triggering event**	**Pre-conditions**	**Assumption**
DMSapp	Continuous		The Grid is continuously monitored The Grid topology is known and reflects the real topology The Grid energy path is known and reflects the real path (effective status of remote monitored and controllable switches)
FLISRapp	Autorecloser operation		Communication system between generic architectural component and control centre where FILISR is hosted is operational
Feeder protection			Backup power/battery is available for operation and communications

4.4.5.3.3 Step by step analysis of the use case

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
1	logical selectivity – FLI along the MV feeder		fault signature handling		The distribution system stakeholders collaborate to handle the fault occurred in a feeder
2	logical selectivity – FLI in the EU plant		fault signature handling		The distribution system stakeholders collaborate to handle the fault occurred in a feeder
3	Anti islanding in case of FLI along the MV feeder		fault signature handling		The distribution system stakeholders collaborate to handle the fault occurred in a feeder

4.4.5.3.4 Steps – Logical selectivity – FLI along the MV feeder

The details of the Str and Op information (directionality, general or per single phase and/or neuter) depends on the type of Protection handling the fault, according to 4.3.2 to 4.3.7.

Scenario								
Scenario name:		Logical selectivity – FLI along the MV feeder						
Step no.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , r-id**
1	Equipment settings/ network maintenance	fault localization and isolation settings	grid topological configuration settings	file transfer or/and client/server interactions and/or proprietary interface	DMSapp (FieldComp config tool functionality)	Substation RTU	grid topological configuration	Utility policy dependant. Could be proprietary or IEC 61850 information exchange
2a			grid topological configuration settings	file transfer or/and client/server interactions and/or proprietary interface	Substation RTU	FeProt-d	IED-level topological configuration	Optional, utility policy dependant. Could be proprietary or IEC 61850 information exchange
2b			grid topological configuration	file transfer or/and	Substation RTU	FeProt-f	IED-level topological	Optional, utility policy

Scenario								
Scenario name:		Logical selectivity – FLI along the MV feeder						
Step no.	Event	Name of process/ activity	Description of process/ activity	Service	Information producer (actor)	Information receiver (actor)	Information exchanged	Additional notes or requirements , r-id
			settings	client/server interactions and/or proprietary interface			configuration	dependant. Could be proprietary or IEC 61850 information exchange
2c			grid topological configuration settings	File Transfer or/and Client/Server interactions and/or proprietary interface	Substation RTU	FeProt-u	IED-level topological configuration	Optional, utility policy dependant. Could be proprietary or IEC 61850 information exchange
2d			grid topological configuration settings	File Transfer or/and Client/Server interactions and/or proprietary interface	Substation RTU	HV/MV SS protection	IED-level topological configuration	Optional, utility policy dependant. Could be proprietary or IEC 61850 information exchange
3a	fault signature (fault on the feeder)	fault detection	fault detection		electric grid	HV/MV SS protection	fault signature	Internal process (fault type analysis)
3a1			(option) internal timer starts for backup protection		FltStr	HV/MV SS protection	HV/MV SS protection	Internal process (backup time-based protection start)
3b			fault detection		electric grid	FeProt-u, FeInd-u	fault signature	Internal process (fault type analysis)
3b1			(option) internal timer starts for backup protection		FeProt-u, FeInd-u		FltStr	Internal process (backup time-based protection start)
3c			fault detection		electric grid	FeProt-f, FeInd-f	fault signature	Internal process (fault type analysis)
3c1			(option) internal timer starts for backup protection		FeProt-f, FeInd-f		FltStr	Internal process (backup time-based protection start)
4a		logical selectivity	Blocking of upstream FtPInds/protections	GOOSE	FeProt-u, FeInd-u	Other FeProt-u, FeInd-u	block	Relevant for UPSTREAM FeProt-u, FeInd-u only

Scenario								
Scenario name:		Logical selectivity – FLI along the MV feeder						
Step no.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , r-id**
								(handling the received blocks). Only the unique unblocked FeProt-u will handle the fault
4b			Blocking of upstream FtPInd/protections	GOOSE	FeProt-f	FeProt-u, FeInd-u	block	Relevant for UPSTREAM FeProt-u, FeInd-u only (handling the received blocks). Only the unique unblocked FeProt-u will handle the fault
4c			Releasing of back-up protection of Upstream FtPInd/Protections	GOOSE	FeProt-f	FeProt-u, FeInd-u	block	Relevant for UPSTREAM FeProt-u, FeInd-u only (handling the received blocks). Upon reception internal timer is stopped to avoid backup operation
4d			Isolating the faulty section	GOOSE	FeProt-u, FeInd-u	other FeProt-u, FeInd-u	block	Relevant for UPSTREAM FeProt-u, FeInd-u only (handling the received blocks). If 4c information is not received, for FeProt, FeInd which internal timer expires operates the breaker and send unblocking /breaker operated information
5a		fault indication	fault analysis	IEC 61850 Report?	HV/MV SS protection	Substation RTU	fault information	Protection Str
5b			fault analysis	IEC 61850 Report?	FeProt-u	Substation RTU	fault information	Protection Str

Scenario								
Scenario name:		Logical selectivity – FLI along the MV feeder						
Step no.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , r-id**
5c			fault analysis	IEC 61850 Report?	FeProt-f	Substation RTU	fault information	Protection Str
6		fault isolation	fault analysis		FeProt-f			Internal process to trip the controlled CB as not blocked by downstream fault detector(s)
7			fault solution	GOOSE/Propri etary	FeProt-f	CB-f	op	Trip the MV/LV SS CB to isolate the fault
8			fault solution	GOOSE/Propri etary	FeProt-f	Anti-Islanding Function	remote disconnection	Ref. to 4.4.5.3.6
9		fault reporting	fault solution	IEC 61850 Report?	FeProt-f	Substation RTU	permanent fault	Protection Op
10a			fault solution		Substation RTU	FtMgtapp	fault localization	On the base of the reports from all the Protections and FtPInd on the faulted feeder
10b			fault solution		Substation RTU	DMSapp	fault localization	On the base of the reports from all the Protections and FtPInd on the faulted feeder
11		fault indication	fault indication		Outage Management System	Field operation personnel	fault localization	Permanent Fault notification
12		system restoration	feeder re-energization		DMSapp	System restoration Function	tbd	Utility based, TBD

4.4.5.3.5 Steps – Logical selectivity – FLI in the EU plant

The details of the Str and Op information (directionality, general or per single phase and/or neuter) depends on the type of Protection handling the fault, according to 4.3.2 to 4.3.7.

Scenario								
Scenario name:		Logical Selectivity – FLI in the EU plant						
Step no.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , r-id**
2a			grid topological configuration settings	file transfer or/and client/server interactions and/or proprietary interface	Substation RTU	FeProt-d	IED-level topological configuration	Optional, utility policy dependant. Could be proprietary or IEC 61850 information exchange
2b			grid topological configuration settings	file transfer or/and client/server interactions and/or proprietary interface	Substation RTU	FeProt-eu	IED-level topological configuration	Optional, utility policy dependant. Could be proprietary or IEC 61850 information exchange
2c			grid topological configuration settings	file transfer or/and client/server interactions and/or proprietary interface	Substation RTU	FeProt-f	IED-level topological configuration	Optional, utility policy dependant. Could be proprietary or IEC 61850 information exchange
2d			grid topological configuration settings	File Transfer or/and Client/Server interactions and/or proprietary interface	Substation RTU	FeProt-u	IED-level topological configuration	Optional, utility policy dependant. Could be proprietary or IEC 61850 information exchange
2e			grid topological configuration settings	File Transfer or/and Client/Server interactions and/or proprietary interface	Substation RTU	HV/MV SS protection	IED-level topological configuration	Optional, utility policy dependant. Could be proprietary or IEC 61850 information exchange
3a	Fault signature (fault in the end	fault detection	fault detection		Electric Grid	HV/MV SS Protection	Fault Signature	Internal process (fault type analysis)

Scenario								
Scenario name:		Logical Selectivity – FLI in the EU plant						
Step no.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , r-id**
	user plant)							
3b			fault detection		Electric Grid	FeProt-u	Fault Signature	Internal process (fault type analysis)
3c			fault detection		Electric Grid	FeProt-eu	Fault Signature	Internal process (fault type analysis)
3d			fault detection		Electric Grid	GP-eu	Fault Signature	Internal process (fault type analysis)
4a		logical selectivity	blocking of upstream FtPInds/protections	GOOSE	FeProt-eu	Broadcast	Block	Relevant for UPSTREAM IEDs only (handling the received blocks). Only the unique unblocked IED will handle the Fault
5			general protection start	GOOSE/Proprietary	GP-eu	FeProt-eu	Protection Str	TBD – For relevant FtPInd-eu local logics
5b			blocking of upstream FtPInd/protections	GOOSE	FeProt-u	Broadcast	Block	Relevant for UPSTREAM IEDs only (handling the received blocks). Only the unique not blocked IED will handle the Fault
6a		fault indication	fault analysis	IEC 61850 Report?	FeProt at main substation	Substation RTU	Fault Information	Protection Str
6b			fault analysis	IEC 61850 Report?	FeProt-u	Substation RTU	Fault Information	Protection Str
7		fault isolation	fault analysis		GeneralProt -eu			Internal process to trip the controlled CB as not blocked by downstream fault detector(s)
8			fault solution	GOOSE/Proprietary	GeneralProt -eu	CB-eu	Op	Trip the MV/LV SS CB to isolate the fault

Scenario								
Scenario name:		Logical Selectivity – FLI in the EU plant						
Step no.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , r-id**
9		fault reporting	fault solution	IEC 61850 Report?	GeneralProt -eu	Substation RTU	Permanent Fault	Protection Op
10a			fault solution		Substation RTU	FtMgtapp	Fault Localization	On the base of the reports from all the Protections and FtPInd on the feeder with faulted EU plant
10b			fault solution		Substation RTU	DMSapp	Fault Localization	On the base of the reports from all the Protections and FtPInd on the feeder with faulted EU plant
11		fault indication	fault indication		FtMgtapp	Field operation personnel	Fault Localization	Permanent fault notification
12		system restoration	feeder re-energization		DMSapp	System restoration Function	TBD	Utility based, TBD

4.4.5.3.6 Steps – Anti-islanding in case of FLI along the MV feeder

The details of the Str and Op information (directionality, general or per single phase and/or neuter) depends on the type of Protection handling the fault, according to 4.3.2 to 4.3.7.

Scenario								
Scenario name:		Anti Islanding in case of FLI along the MV feeder						
Step no.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , r-id**
1	remote disconnection	anti islanding	anti islanding	GOOSE	FeProt-f	GeneralProt -eu	Remote Trip	In general to all the interface protections of the distributed generation downstream the fault

Scenario								
Scenario name:		Anti Islanding in case of FLI along the MV feeder						
Step no.	**Event**	**Name of process/ activity**	**Description of process/ activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , r-id**
2			anti islanding	GOOSE/Proprietary	GeneralProt -eu	GeneratorInterfaceProt -eu	Transfer Trip	
3			anti islanding	GOOSE/Proprietary	GeneratorInterfaceProt -eu	GeneratorInterfaceDisconnect -eu	Op	
4			anti islanding	GOOSE/Proprietary	GeneratorInterfaceDisconnect -eu	GeneralProt -eu	GeneratorInterfaceProt Status	Optional TBD – For relevant FtPInd-eu local logics

4.4.5.4 Information exchanged

Information exchanged		
Name of information exchanged	**Description of information exchanged**	**Requirements to information data** **R-id**
IED-level topological information (for configuration)	Topological addressing (structured information) of IEDs involved in DA on the feeder; dynamical definition of the relationship with neighbour IEDs (up/down-stream)	New DO in new LN
remote disconnection	Anti-islanding of a MV feeder trunk affected by a fault	New DO/DA or new LN
GP Start	Protection dependant (directionality, general or per single phase and/or neuter, etc.)	Will be mapped over Str of the appropriate P-Type LN
remote trip	Anti-islanding of a MV feeder trunk affected by a fault	New DO/DA or new LN
transfer trip	To open the ICB	New DO/DA or new LN

4.4.6 Contribute to distributed automatic VVC

Not developed yet.

4.4.7 Contribute to distributed DER management

Not developed yet.

4.5 Use cases related to "Product life cycle"

4.5.1 IED configuration via CID file

4.5.1.1 Description of the use case

4.5.1.1.1 Name of use case

Use case identification		
ID	**Domain(s)**	**Name of the use case**
	Distribution automation	Configuration of FPIs participating in DA.

4.5.1.1.2 Version management

Version management						
Version management changes/ version	**Date**	**Name author(s) or committee**	**Domain expert**	**Area of expertise/ domain/role**	**Title**	**Approval status draft, for comments, for voting, final**
First version in IEC template		JAHWG 51				Draft

4.5.1.1.3 Scope and objectives of the use case

Scope and objectives of the use case	
Related business case	Distribution network operation
Scope	Configuration of newly introduced FPIs (IED) or updating of the configuration of existing ones participating to a DA. The configuration data includes topological information.
Objective	Make dynamic the configuration of the IEDs, helping the distributed control to adapt to topological changes.

4.5.1.1.4 Narrative of the use case

Narrative of the use case
Short description
By running this use case, each FPI located along the feeder and participating to its distributed automation will receive the relevant information for the setting and configuration, including the communication and topology information.
Complete description
The following steps describe how the function works. **Configuration of IEDs newly introduced in a feeder** A DAS can consist of hundreds or even thousands of equipments, and the configuration of the primary systems may change time by time. The FPIs in the system are configured per feeder base. When a new feeder (or a group of connected feeders) is introduced, the relevant SCL files for the exercise and configuration of the distribution network will be generated and distributed to the equipments in the Substations (and Control centres). The utility will decide which SCL in which equipments will be used. The focus of this use case is the FPI and therefore the generation and handling of ICD and CID files. Besides the project specific communication parameters, settings and modelling (LD instances, LN instances, Datatypetemplates), the configuration also deals with the needed local topology information as well as the relationship with the adjacent IEDs participating to distributed functions. If the IEDs are configured remotely, the IEDs are first configured with communication parameters, and communication links between the new IED and the remote configuration tool are established. Then the configuration data is sent to each IEDs. If the IEDs are configured locally in the field, the configuration data is uploaded to the IED directly from the local configurator. Each concerned IEDs (configured locally or remotely) registers as a member of the distributed feeder automation function. This application is regularly checked, in order to adapt to any configuration change. **Configuration of a single newly introduced IED** If a new IED is introduced in a feeder where IEDs already exist, a new CID will be created by the system configurator according to the implemented Distributed Automation functions, local communication network and topology information basing on the ICD file of the IED. The ICD then will be uploaded to the IED remotely or locally. **Updating the configuration of existing IEDs** The configuration of an existing IED may need to be updated for changes due to new setting of the implemented functions and/or the communication parameters, to fault resolution up to changes in the grid structure. Accordingly, the procedure could be different, from just some setting/parameter update (topological information, direction of protection sectors) up to complete reconfiguration. The procedures concerning the elaboration of CID files starting from the ICD (for new IEDs) or modifying the current CID files, their storage (in the system engineering tools or downloaded on request from the IED) are not binding. The CID/CID will be updated for the needed changes and the new CID will be uploaded to the IED. **System management behaviour** In order to ensure the consistency of the distributed function, the distributed function can be suspended or resumed.

4.5.1.1.5 General remarks

General remarks
Configuration procedures can be done at the control centre or in the field by IED configuration engineer. If the configuring is at the control center, it is assumed that the IED have been configured with basic communication parameters, connected to the communication network and the link between IED and related Primary Substation has already been established. If the primary system of a feeder changes, the grid status and topology has to be modified. The IED configurator collects all the required information to process and produce the CID file for each IED. The FPI (IED) stores a stable CID (default or due to former configuration) in case of aborted configuration. The configuration/reconfiguration procedures involve manual and automatic actions.

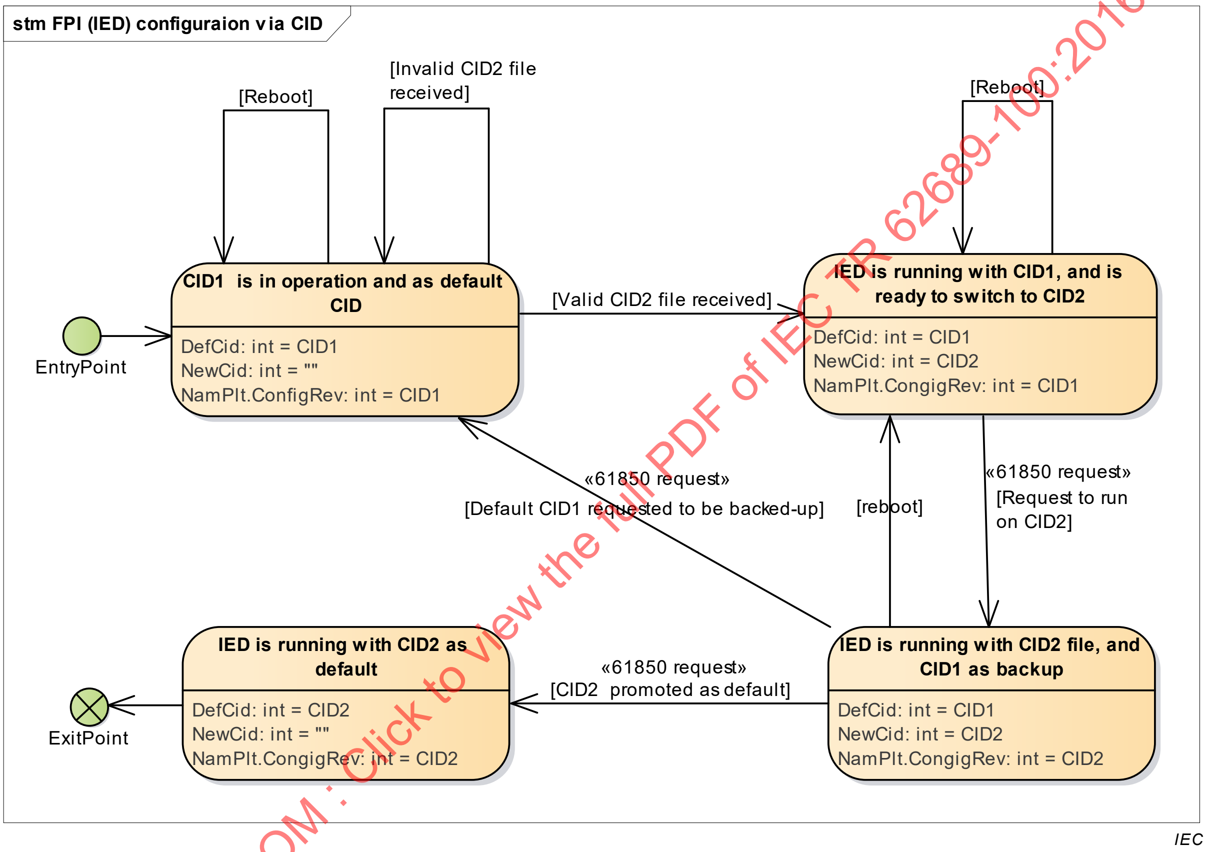


Figure 17 – IED configuration process via CID

Cyber security: minimum data for a trusted connection (TBD).

4.5.1.2 Diagrams of the use case

Figures 18 to 25 show the typical sequence diagram for handling the use case.

Diagram of the use case

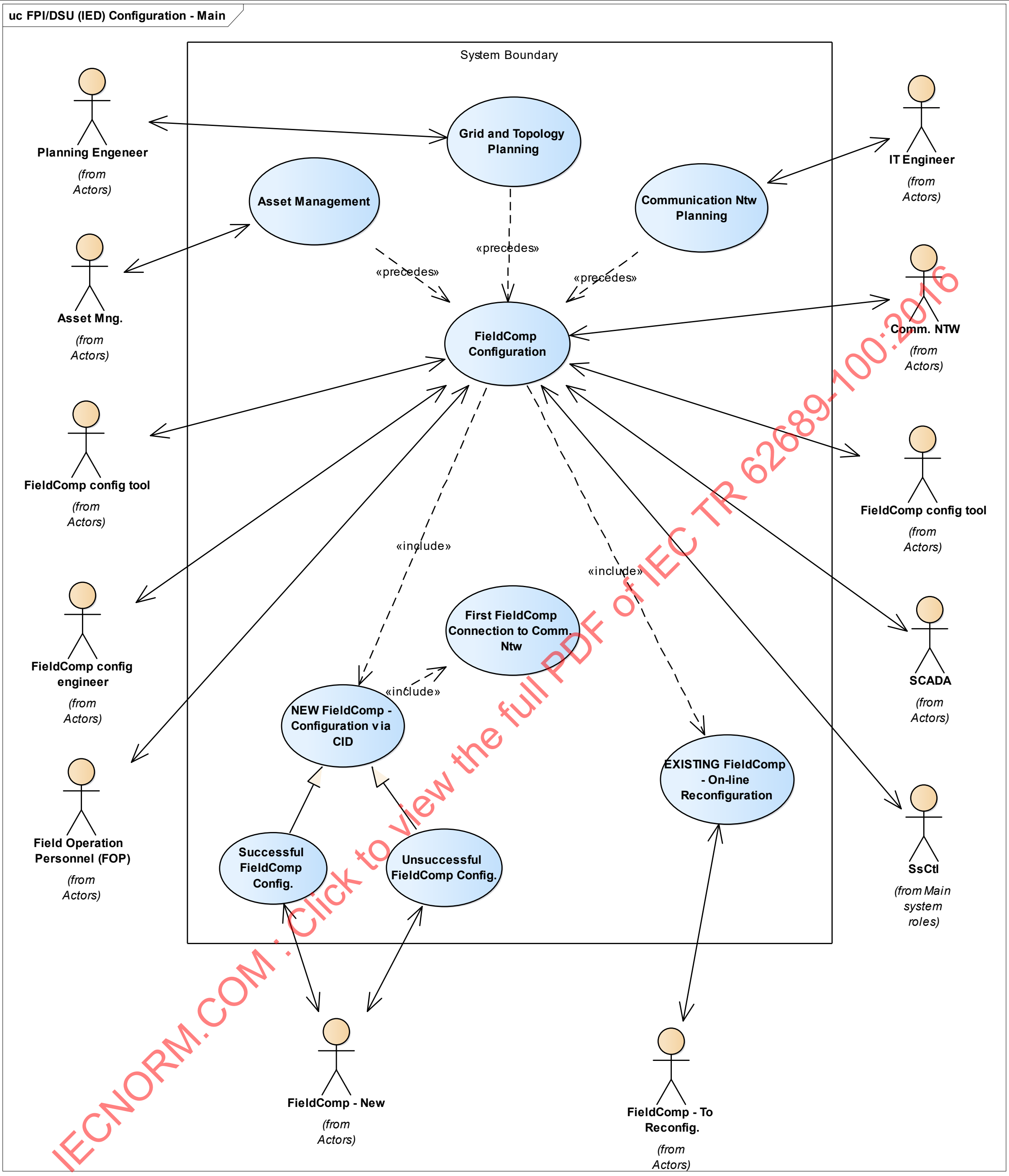


Figure 18 – FieldComp configuration – Main UC

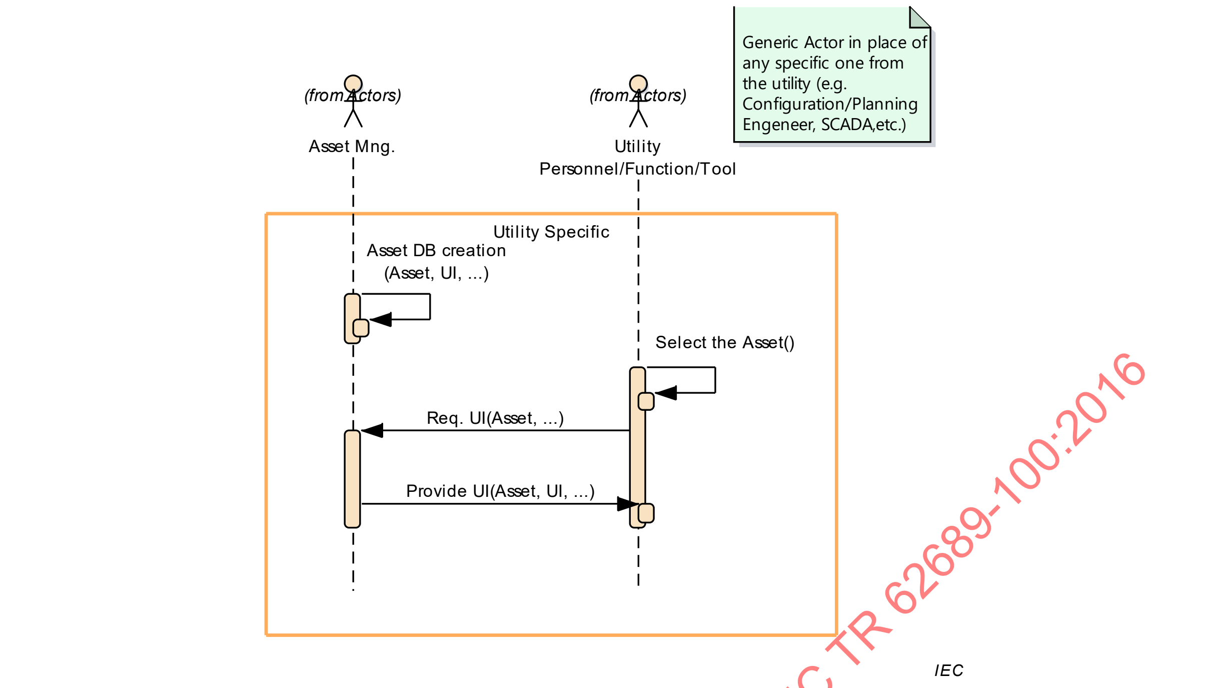


Figure 19 – FieldComp asset management

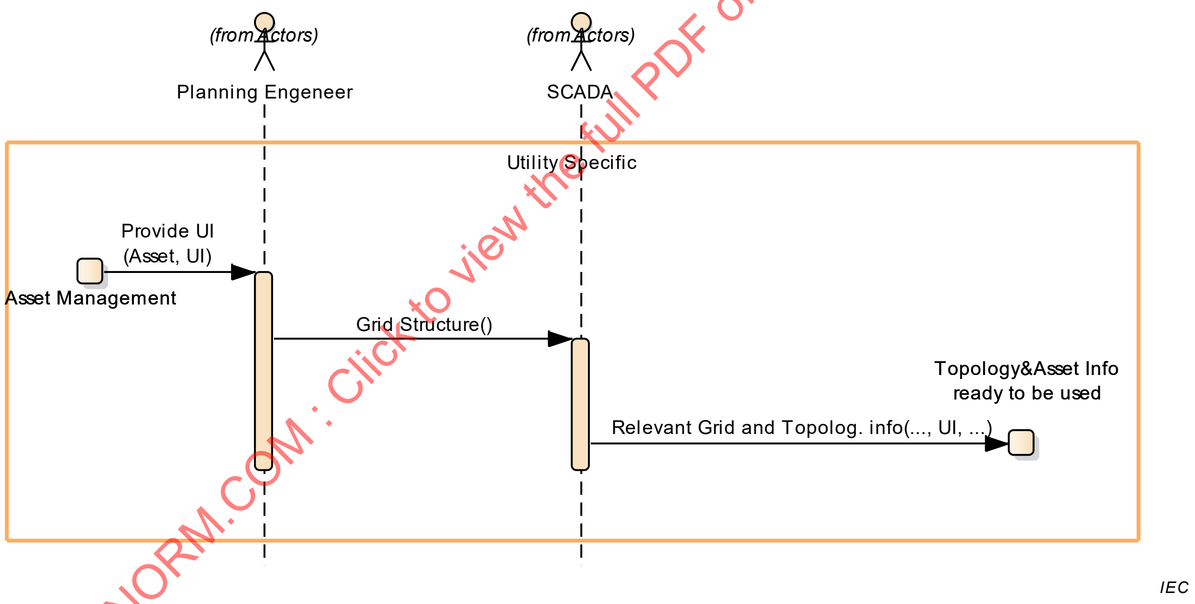


Figure 20 – Grid and topology planning

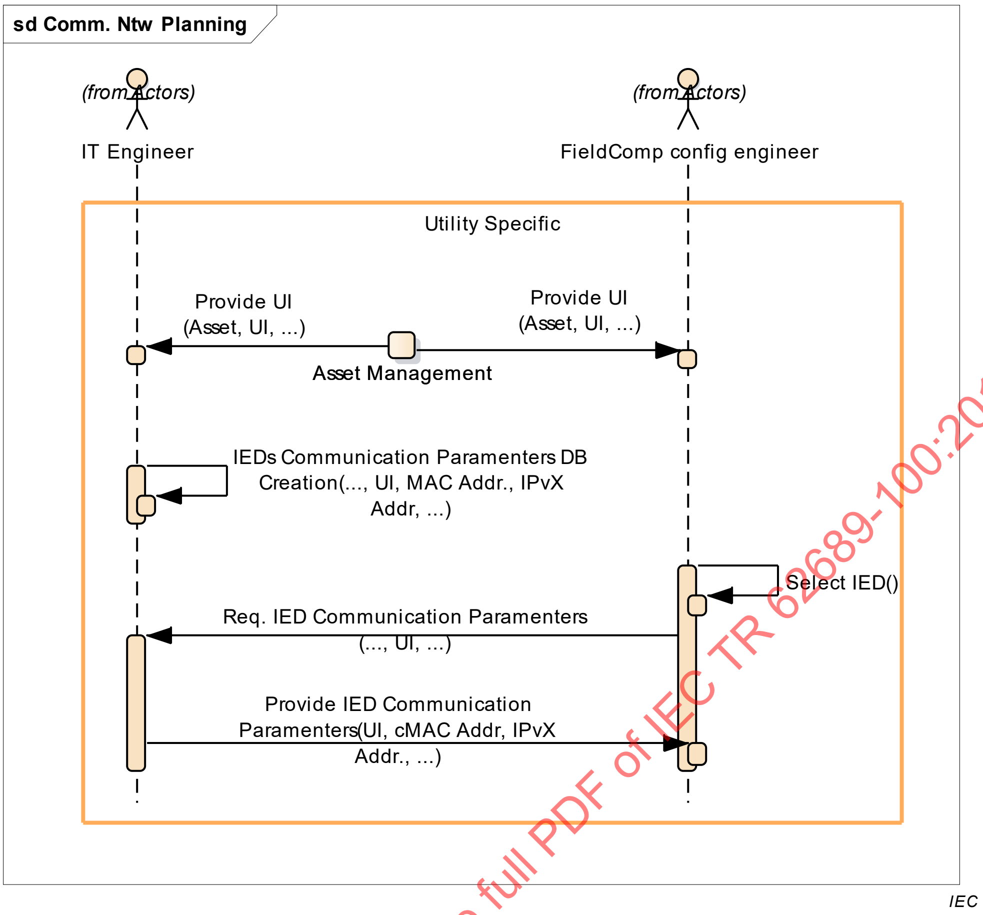


Figure 21 – Communication network planning

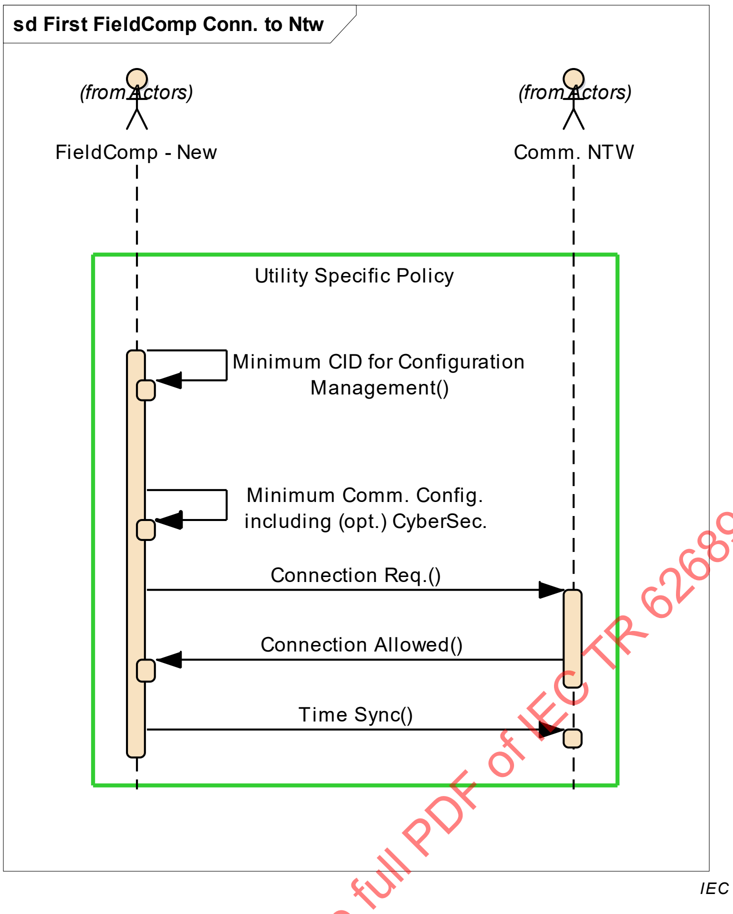


Figure 22 – First FieldComp connection to communication network

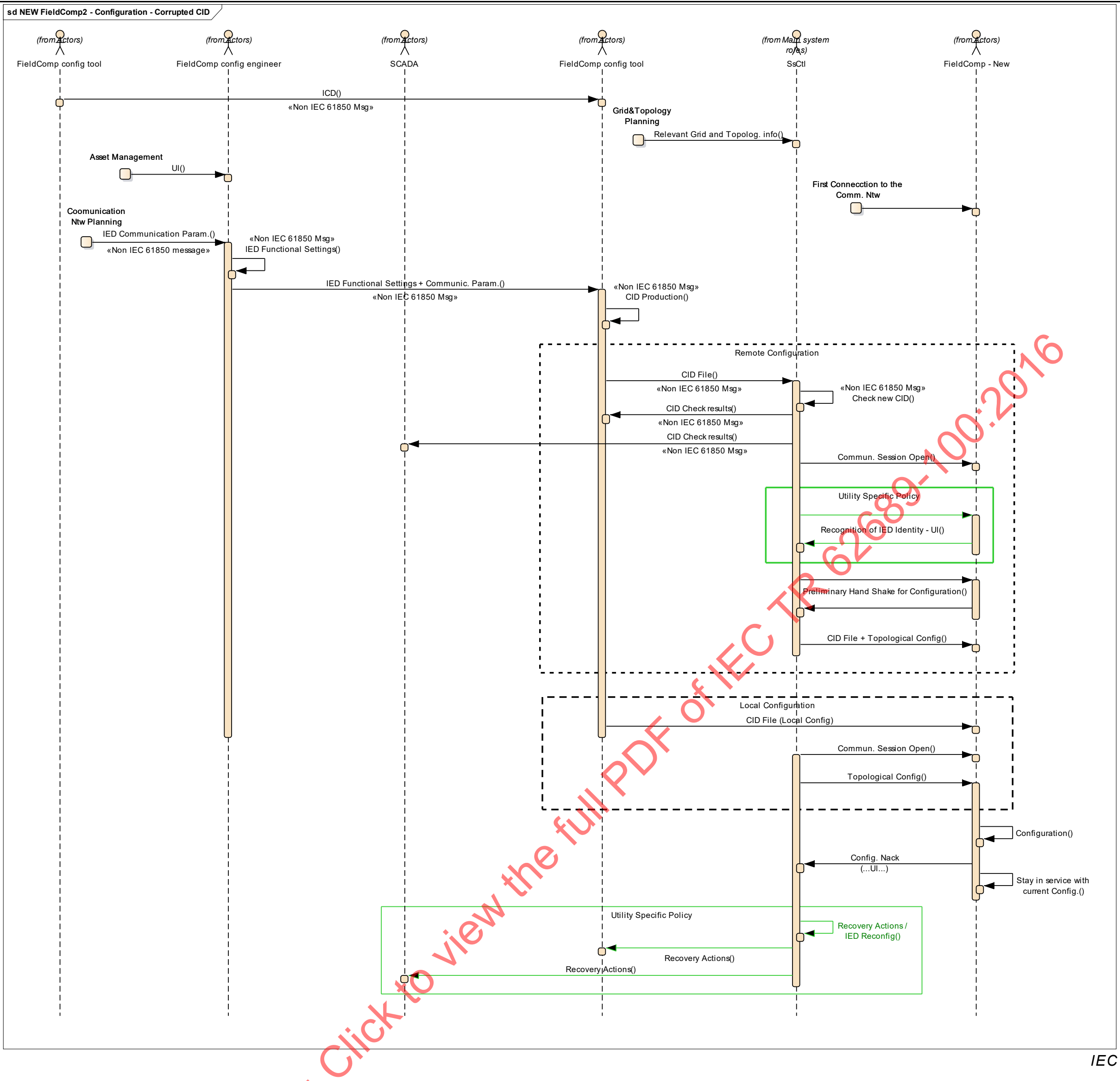


Figure 23 – New FieldComp configuration via CID – Remote + local (successful case)

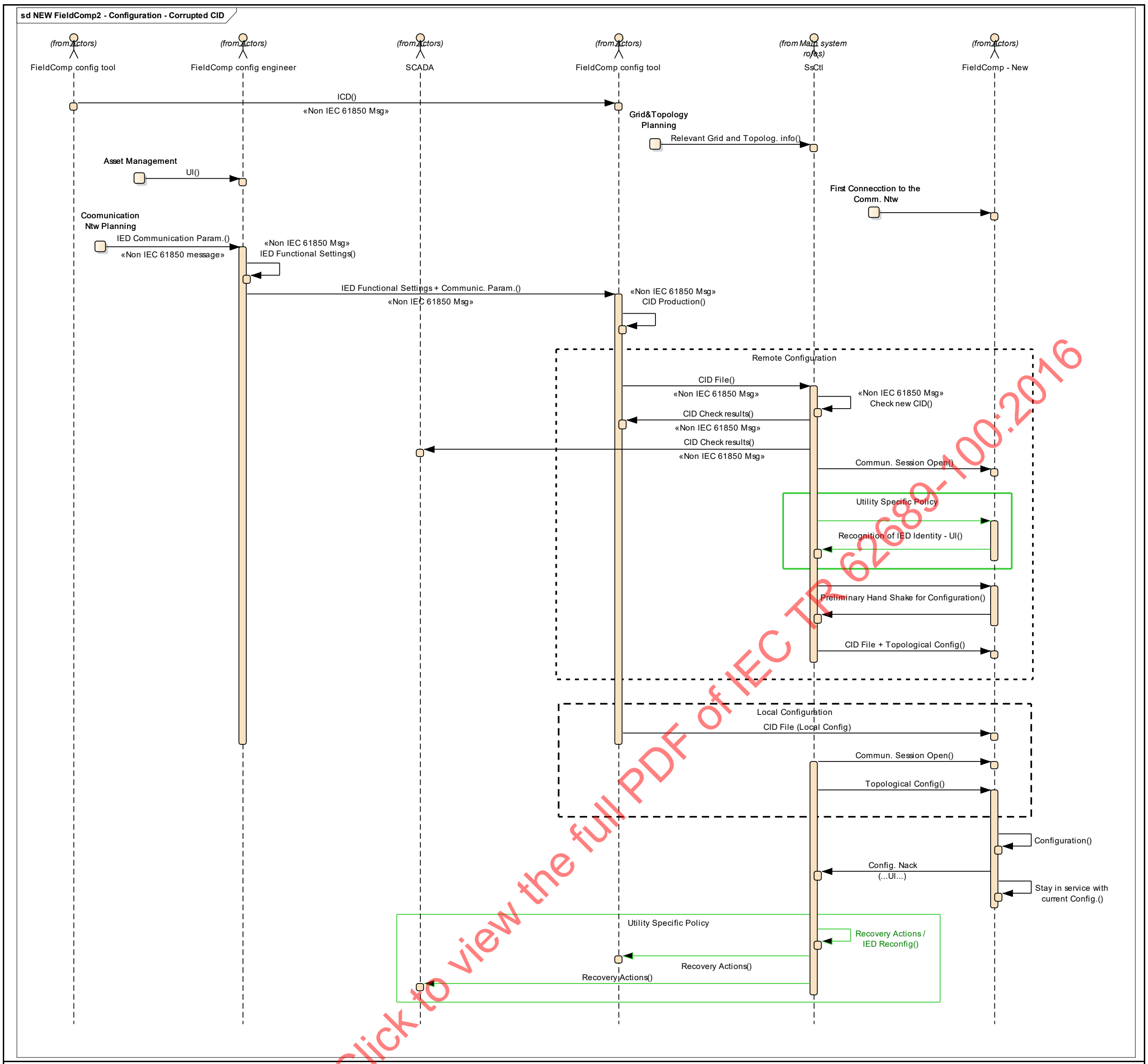


Figure 24 – New FieldComp configuration via CID – Remote + local (unsuccessful case – corrupted CID)

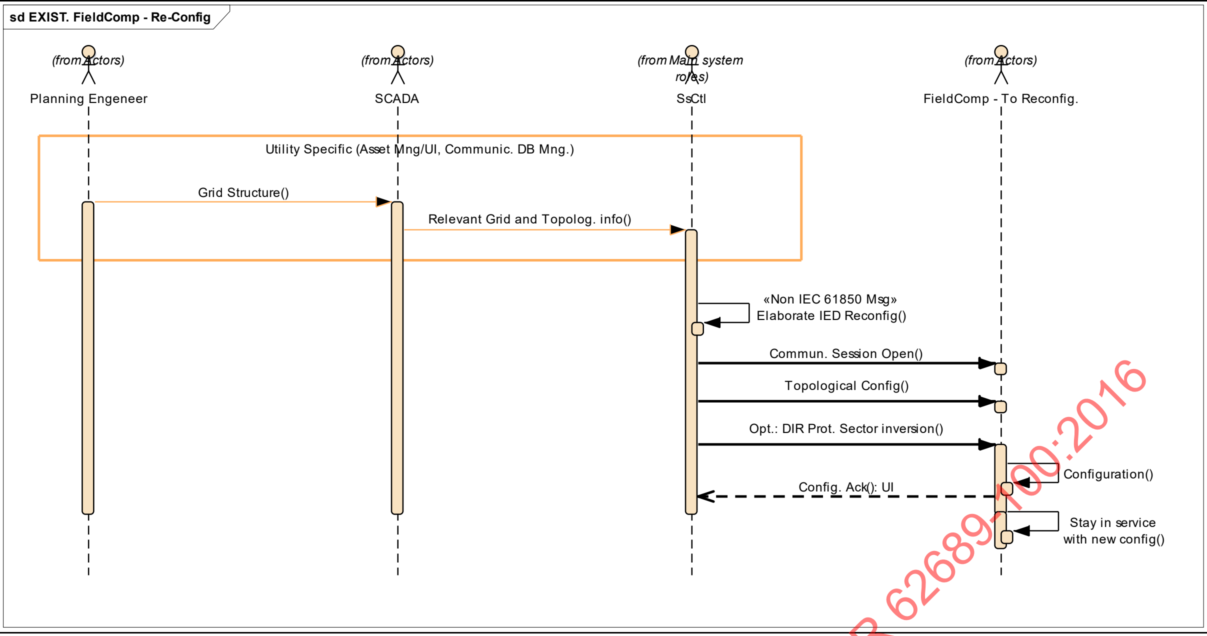


Figure 25 – Existing FieldComp on-line reconfiguration – (topology – successful case)

4.5.1.3 Technical details

4.5.1.3.1 Actors: people, systems, applications, databases, the power system, and other stakeholders

Actors			
Grouping (community)		**Group description**	
Actor name **see actor list**	**Actor type** **see actor list**	**Actor description** **see Actor list**	**Further information specific to this use case**
FieldComp – New	Device	Ref. 4.2	New FieldComp (one or more) to be configured which has/have physical connectivity with other FieldComps/FieldComps in a MV feeder of a Primary Substation.
FieldComp – To reconfig	Device	Ref. 4.2	FieldComps whose CID file has to be reedit because of changes on the related contents. In case of topology changes, just a parameter reconfiguration without complete file change can be applied.
FieldComp manufacturer	People	Manufacturer of the FieldComp.	
IT engineer	People	Personnel that manages the communication infrastructure for the DA, providing all the related parameters for the configuration of the FieldComp.	
Planning engineer	People	Personnel in charge of Electric Network Planning.	
FieldComp config engineer	People	Ref. 4.2	
AssetMngApp.	System	Ref. 4.2	
Field Operation Personnel	People	Ref. 4.2	
SCADA	Device	Distribution network monitoring system at control center – Creator of the Topological status of the distribution network according to the current Grid structure.	
Substation RTU	Device	Ref. 4.2.	RTU of the Primary substation, handling the communication to the FieldComps locally and to its MV feeders; it retains the topological info, elaborated in the Central SCADA, concerning its section of distribution network.
FieldComp configuration tool	Device	Ref. 4.2.	
Communication GRID	System	Secondary network in the Power distribution system supporting all the configuration, automation and statistical tasks of an utility	Both LAN and WAN.

4.5.1.3.2 Preconditions, assumptions, post condition, events

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**

4.5.1.4 Step-by-step analysis of the use case

4.5.1.4.1 General

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
1	FieldComp Asset management		Update of Utility asset management		Related info updated and available to the Utility functions
2	Grid and topology planning		Update of Grid and its topology		Related info updated and available to the Utility Functions
3	Communication grid planning		Update of Communication grid structure, nodes and addresses		Related info updated and available to the Utility functions
4	First FieldComp Connection to Communication network		Basic messaging at first IRD/FieldComp connection to the Communication grid		The FieldComp is part of the Comm. grid, ready for a complete configuration/setting
5	NEW FieldComp Configuration via CID – Remote + Local (Successful case)		Complete configuration and setting of a new FieldComp to start working in the DAS		The new FieldComp is in exercise with the applied configuration
6	NEW FieldComp Configuration via CID – Remote + Local (Unsuccessful case – Corrupted CID)		Complete configuration and setting of a new FieldComp to start working in the DAS		The FieldComp is not in exercise with the applied configuration
T.B.D.	NEW FieldComp – Configuration (Unsuccessful case – FieldComp SW failure)		Complete configuration and setting of a new FieldComp to start working in the DAS		The FieldComp is not in exercise with the applied configuration
…	…		…		…
7	Existing FieldComp On-line reconfiguration (topology – Successful case)		Partial configuration of a working FieldComp due to the topological changes in the power distribution network		The FieldComp is again in exercise with the new configuration
T.B.D.	Existing FieldComp Re-configuration (Grid modification – Successful case)		Complete configuration and setting of a working FieldComp in the DAS		The FieldComp is again in exercise with the new configuration

4.5.1.4.2 Steps – FieldComp asset management

Scenario								
Scenario name		FieldComp Asset Management						
Step No.	Event	Name of process/ activity	Description of process/activity	Service	Information producer (actor)	Information receiver (actor)	Information exchanged	Additional notes or requirements , R-ID
1	New asset in the Utility	Utility asset management	Creation of the asset DB entry		Asset manager		Asset type, unique identifier (UI)	Internal process
2	First installation/modification of FieldComp in the distribution network	FieldComp configuration	FieldComp parameters collection		Utility personnel/ Function/Tool	Asset manager	Asset type	
3			FieldComp parameters collection		Asset manager	Utility personnel/Tool	Asset type, unique identifier (UI)	

4.5.1.4.3 Grid and topology planning

Scenario								
Scenario name		Grid and Topology Planning						
Step No.	Event	Name of process/ activity	Description of process/activity	Service	Information producer (actor)	Information receiver (actor)	Information exchanged	Additional notes or requirements , R-ID
1	First installation/modification of FieldComps (and other equipments) in the distribution network	Grid and Topology planning	Grid topology construction, according to the distribution Grid structure and status		Asset mng	Planning engineer	Asset Type, UI	
2			Grid topology construction, according to the distribution Grid structure and status		Planning engineer	SCADA	Grid structure, including FieldComp topological address and UI	

Scenario								
Scenario name		**Grid and Topology Planning**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , R-ID**
3			Grid topology construction through the FieldComp configuration (topological part, according the distribution Grid structure and status)	File Transfer or/and Client/ Server interactions and/or proprietary interface	SCADA	Distribution utility personnel/Tools	Grid structure, including FieldComp topological address and UI	Optional, Utility policy dependant. Could be proprietary or IEC 61850 information exchange

4.5.1.4.4 Communication Network Planning

Scenario								
Scenario name		**Communication Network planning**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , R-ID**
1a	First installation/ maintenance of FieldComps (and other equipments) in the distribution network	Communication grid planning according to the FieldComps and their location on the Feeders)	FieldComp parameters collection		Asset manager	IT engineer	Asset Type, UI,…	
2			Creation of the CommunicationDB (in particular the relevant FieldComps parameters)		IT engineer		…,Unique Identifier (UI), MAC Addr., IPv4/6 Addr.,…	Internal process
1b		Configuration of the FieldComps	FieldComp parameters collection		Asset manager	Configuration engineer	Asset Type, UI,…	
3			FieldComp parameters collection		Configuration engineer	IT engineer	…, UI,…	

Scenario								
Scenario name		Communication Network planning						
Step No.	Event	Name of process/ activity	Description of process/activity	Service	Information producer (actor)	Information receiver (actor)	Information exchanged	Additional notes or requirements , R-ID
4			FieldComp parameters collection		IT engineer	Configuration engineer	…,UI, MAC Addr., IPv4/6 Addr.,…	

4.5.1.4.5 First FieldComp connection to communication network

Scenario								
Scenario name		First FieldComp Connection to Communication Network						
Step No.	Event	Name of process/ activity	Description of process/activity	Service	Information producer (actor)	Information receiver (actor)	Information exchanged	Additional notes or requirements , R-ID
1	New FieldComp in the distribution grid	Minimum configuration for the connection to the Communication grid	Configuration via minimum CID		Utility/Manufacturer dependant	FieldComp		At least embedded from the manufacturer in accordance with the Utility requirements
2			Configuration via minimum Communication parameters		Utility dependant	FieldComp		At least embedded from the manufacturer in accordance with the Utility requirements
3		Activate the FieldComp in the Utility grid (including Communication)	Connection request		FieldComp	Communication grid		
4			Connection allowed		Communication grid	FieldComp		
5			Time synchronization	IEC61850 Time Synchronisation service /Others	FieldComp	Communication grid		

4.5.1.4.6 Steps – NEW FieldComp configuration via CID – Remote + local (successful case)

Scenario								
Scenario name		NEW FieldComp configuration via CID – Remote (successful case)						
Step No.	Event	Name of process/ activity	Description of process/activity	Service	Information producer (actor)	Information receiver (actor)	Information exchanged	Additional notes or requirements , R-ID
1	New FieldComp installed in the distribution grid	New FieldComp configuration	FieldComp's manufacturer provides an ICD file to be handled in the FieldComp configurator		FieldComp manufacturer	FieldComp configurator	ICD file	Depending on Utility and/or Manufacturer/Supplier policies
2		New FieldComp configuration and related Substation RTU	Grid and Topology info related to the distribution subGrid the FieldComp is included in		SCADA	Substation RTU	Relevant grid and Topology info	Ref. Figure 20 and 4.5.1.4.3
3		New FieldComp configuration	Asset info related to the FieldComp		Asset mng.	Configuration Engineer		Ref. Figure 19 and 4.5.1.4.2
4		New FieldComp configuration	First connection to the Communication grid		Communication grid	FieldComp – New		Ref. Figure 22 and 4.5.1.4.5
5		New FieldComp configuration	Communication parameters related to the FieldComp		IT engineer	Configuration engineer	FieldComp Communication parameters	Ref. Figure 21 and 4.5.1.4.4
6		New FieldComp configuration	FieldComp Functional Settings		Configuration engineer		Internal activity	e.g.: FLISR and automation related functions
7		New FieldComp configuration	FieldComp configuration and setting		Configuration engineer	FieldComp configurator		Imputation in the tool of the Functional and Communicational parameters
8		New FieldComp configuration and related Substation RTU	CID File preparation (1)		FieldComp configurator	Substation RTU	FieldComp CID file (semi-complete, without Topological info)	
9		New FieldComp configuration and related Substation RTU	CID File validation (1)		Substation RTU	FieldComp configurator		

Scenario								
Scenario name		NEW FieldComp configuration via CID – Remote (successful case)						
Step No.	**Event**	**Name of process/ activity**	**Description of process/activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , R-ID**
10		New FieldComp configuration and related Substation RTU	CID file validation (1)		Substation RTU	SCADA		
11		New FieldComp configuration	Communication Session instantiation	Client/Server interactions and/or proprietary interface	Substation RTU	FieldComp – New		Utility policy dependant. Could be proprietary or IEC 61850 information exchange
12		New FieldComp configuration	FieldComp recognition	Client/Server interactions and/or proprietary interface	Substation RTU	FieldComp – New	Recognition request	Utility policy dependant. Could be proprietary or IEC 61850 information exchange
13		New FieldComp configuration	FieldComp recognition	Client/Server interactions and/or proprietary interface	FieldComp – New	Substation RTU	Recognition response (…,UI,…)	Utility policy dependant. Could be proprietary or IEC 61850 information exchange
14		New FieldComp configuration	Preliminary Hand-shake for FieldComp configuration	Client/Server interactions and/or proprietary interface	Substation RTU	FieldComp – New		According to IEC 61850 or other standards Acknowledged procedure
15		New FieldComp configuration	FieldComp configuration and Setting data transfer	Client/Server interactions and/or proprietary interface	Substation RTU	FieldComp – New	Functional, topological and communicational parameters	According to IEC 61850 (client/server File Transfer) or other standards Acknowledged procedure Ref. also to Figure 17
16		New FieldComp configuration	Application of the received configuration		FieldComp – New			Internal process, Ref. also to Figure 17

Scenario								
Scenario name		**NEW FieldComp configuration via CID – Remote (successful case)**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , R-ID**
17		New FieldComp configuration	Successful configuration process notification	Client/Server interactions and/or proprietary interface	FieldComp – New	Substation RTU	Config. Result, opt. UI	Ref. also to Figure 17
18		New FieldComp configuration	Reboot with the received configuration	Client/Server interactions and/or proprietary interface	Substation RTU	FieldComp – New	Reboot request, opt. Time&Date	Immediate reboot; optionally, time and date of scheduled reboot (to synchronize the activation in-service of multiple FieldComps on the same feeder with a coherent configuration) Ref. also to Figure 17
19		New FieldComp configuration	Opt.: promote the last configuration as the default one in case of reboot (for any reason) of the FieldComp	Client/Server interactions and/or proprietary interface	Substation RTU	FieldComp – New	Default/stable Config.	Last received configuration is the default/stable one in case of FieldComp future reboot Acknowledged procedure Ref. also to Figure 17

Scenario								
Scenario name		**NEW FieldComp configuration – Local (successful case)**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , R-ID**
1	New FieldComp installed in the distribution Grid	New FieldComp configuration	FieldComp's manufacturer provides an ICD file to be handled in the FieldComp configurator		FieldComp manufacturer	FieldComp Configurator	ICD file	Depending on Utility and/or Manufacturer/Supplier policies

Scenario								
Scenario name		**NEW FieldComp configuration – Local (successful case)**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , R-ID**
2		New FieldComp configuration and related Substation RTU	Grid and Topology info related to the distribution subGrid the FieldComp is included in		SCADA	Substation RTU	Relevant Grid and Topology info	Ref. Figure 20 and 4.5.1.4.3
3		New FieldComp configuration	Asset info related to the FieldComp		Asset mng.	Configuration Engineer		Ref. Figure 19 and 4.5.1.4.2
4		New FieldComp configuration	First connection to the Communication grid		Communication grid	FieldComp – New		Ref. Figure 22 and 4.5.1.4.5
5		New FieldComp configuration	Communication parameters related to the FieldComp		IT Engineer	Configuration engineer	FieldComp Communication parameters	Ref. Figure 21 and 4.5.1.4.4
6		New FieldComp configuration	FieldComp functional settings		Configuration engineer		Internal Activity	e.g.: FLISR and automation related functions
7		New FieldComp configuration	FieldComp configuration and setting		Configuration engineer	FieldComp configurator		Imputation in the tool of the Functional and communicational parameters
8		New FieldComp configuration	FieldComp configuration and setting data transfer	Client/Server interactions and/or proprietary interface	FieldComp configurator	FieldComp – New	Functional and communicational parameters	According to IEC 61850 (client/server File transfer) or other standards Acknowledged procedure Ref. also to Figure 17
9		New FieldComp configuration	Communication Session instantiation	Client/Server interactions and/or proprietary interface	Substation RTU	FieldComp – New		Utility Policy dependant. Could be proprietary or IEC 61850 information exchange
10		New FieldComp configuration	FieldComp Topological configuration	Client/Server interactions and/or proprietary interface	Substation RTU	FieldComp – New		Utility Policy dependant. Could be proprietary or IEC 61850 information exchange

Scenario								
Scenario name		NEW FieldComp configuration – Local (successful case)						
Step No.	**Event**	**Name of process/ activity**	**Description of process/activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , R-ID**
11		New FieldComp configuration	Application of the received configuration		FieldComp – New			Internal process, Ref. also to Figure 17
12		New FieldComp configuration	Successful configuration process notification	Client/Server interactions and/or proprietary interface	FieldComp – New	Substation RTU	Config. Result, opt. UI	Ref. also to Figure 17
13		New FieldComp configuration	Reboot with the received configuration	Client/Server interactions and/or proprietary interface	Substation RTU	FieldComp – New	Reboot request, opt. Time&Date	Immediate reboot; optionally, time and date of scheduled reboot (to synchronize the activation in-service of multiple FieldComps on the same feeder with a coherent configuration) Ref. also to Figure 17
14		New FieldComp configuration	Opt.: promote the last configuration as the default one in case of reboot (for any reason) of the FieldComp	Client/Server interactions and/or proprietary interface	Substation RTU	FieldComp – New	Default/stable Config.	Last received configuration is the default/stable one in case of FieldComp future reboot Acknowledged procedure Ref. also to Figure 17

4.5.1.4.7 Steps – NEW FieldComp configuration remote + local (unsuccessful case – corrupted CID)

Scenario								
Scenario name		NEW FieldComp configuration remote (unsuccessful case – corrupted CID)						
Step No.	Event	Name of process/ activity	Description of process/activity	Service	Information producer (actor)	Information receiver (actor)	Information exchanged	Additional notes or requirements , R-ID
1 to 16	New FieldComp installed in the distribution Grid	Ref to Steps 1 to 15 of 4.5.1.4.6, remote case						
17		New FieldComp configuration	Unsuccessful configuration process notification	Client/Server interactions and/or proprietary interface	FieldComp – New	Substation RTU	Config. Result, opt. UI	Ref. also to Figure 17
18		New FieldComp configuration	Stay in service with running/default configuration		FieldComp – New			Internal process; Ref. also to Figure 17
19		New FieldComp configuration	Opt.: Recovery actions after faulty FieldComp configuration		Substation RTU	FieldComp configurator		Utility Policy dependant. For new Configuration preparation
20		New FieldComp configuration	Opt.: Recovery actions after faulty FieldComp configuration		Substation RTU	SCADA		Utility policy dependant. For distribution grid topology handling

Scenario								
Scenario name		**NEW FieldComp configuration local (unsuccessful case – corrupted CID)**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/ Activity**	**Service**	**Information producer(ctor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , R-ID**
1 to 11	New FieldComp installed in the distribution grid	Ref to Steps 1 to11 of 4.5.1.4.6, local case						
12		New FieldComp configuration	Unsuccessful configuration process notification	Client/Server interactions and/or proprietary interface	FieldComp – New	Substation RTU	Config. Result, opt. UI	Ref. also to Figure 17
13		New FieldComp configuration	Stay in service with running/default configuration		FieldComp – New			Internal process; Ref. also to Figure 17
14		New FieldComp configuration	Opt.: Recovery actions after faulty FieldComp configuration		Substation RTU	FieldComp configurator		Utility policy dependant. For new Configuration preparation
15		New FieldComp configuration	Opt.: Recovery actions after faulty FieldComp configuration		Substation RTU	SCADA		Utility Policy dependant. For distribution grid topology handling

4.5.1.4.8 Steps – Existing FPI on-line reconfiguration (topology – successful case)

Scenario								
Scenario name		**Existing FPI on-line reconfiguration (topology – successful case)**						
Step No.	**Event**	**Name of process/ activity**	**Description of process/activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**	**Additional notes or requirements , R-ID**
1	Topological modification of the distribution grid	Existing/ In Service FieldComp re-configuration	Topological modification of the Grid according to the distribution Grid structure and status		Planning Engineer	SCADA	Grid Structure, including FieldComp topological address and UI	Utility policy, e.g. just the Grid sections affected by modifications

Scenario								
Scenario name		Existing FPI on-line reconfiguration (topology – successful case)						
Step No.	Event	Name of process/ activity	Description of process/activity	Service	Information producer (actor)	Information receiver (actor)	Information exchanged	Additional notes or requirements , R-ID
2			Topological modification of the Grid according to the distribution Grid structure and status	File Transfer or/and Client/Server interactions and/or proprietary interface	SCADA	Substation RTU	Grid Structure, including FieldComp topological address and UI	Grid section relevant for the SS/feeder where the FieldComp is installed
3			Preparation of topological information for FieldComp		Substation RTU			Internal process
4		Existing/ In Service FieldComp re-configuration	Communication session instantiation	Client/Server interactions and/or proprietary interface	Substation RTU	FieldComp – To Reconfig.		Utility policy dependant. Could be proprietary or IEC 61850 information exchange
5		Existing/ In Service FieldComp re-configuration	FieldComp configuration data transfer	Client/Server interactions (or proprietary interface)	Substation RTU	FieldComp – To Reconfig.	Topological parameters	Utility policy dependant According to IEC 61850 (client/server data set) or other standards Acknowledged procedure
6		Existing/ In Service FieldComp re-configuration	Opt. Sector Inversion for Directional Protection functions if topology changes	Client/Server interactions (or proprietary interface)	Substation RTU	FieldComp – To Reconfig.	Protection Sectors settings	Utility Policy dependant According to IEC 61850 (client/server data set) or other standards Acknowledged procedure
7		Existing/ In Service FieldComp re-configuration	Stay in service with new configuration		FieldComp – To Reconfig.			Internal process

4.5.1.5 Information exchanged

Information exchanged		
Name of information exchanged	**Description of information exchanged**	**Requirements to information data** **R-ID**
CID	Configured FieldComp description file, including instantiated data models and the configuration of communication and topological parameters.	
IED-level topological information	Ref. to 4.4.5.4, same item.	Ref. to 4.4.5.4, same item.
Configuration results	Spontaneous notifications concerning the result of the FieldComp configuration (e.g. Config. OK, Config. Not Ok, other anomalies detected)	New DO/DA in new LN
Reboot with new Config.	Command from Central entity (function/personnel) to restart the FieldComp, optionally including Schedule info (Time&Date)	New DO/DA in new LN
Last Config is Default	Command from Central entity (function/personnel) to promote the last Configuration as the default/stable one	New DO/DA in new LN
Inversion of sector direction	To change the directionality of protection functionalities when the topology changes	None or new DO/DA only if new P-type LN

5 Information Models

5.1 Mapping of requirements on LNs

5.1.1 General

5.1 describes the mapping to LNs of requirements described by use cases in 4.

5.1.2 Mapping of the requirements of Fault Identification and report

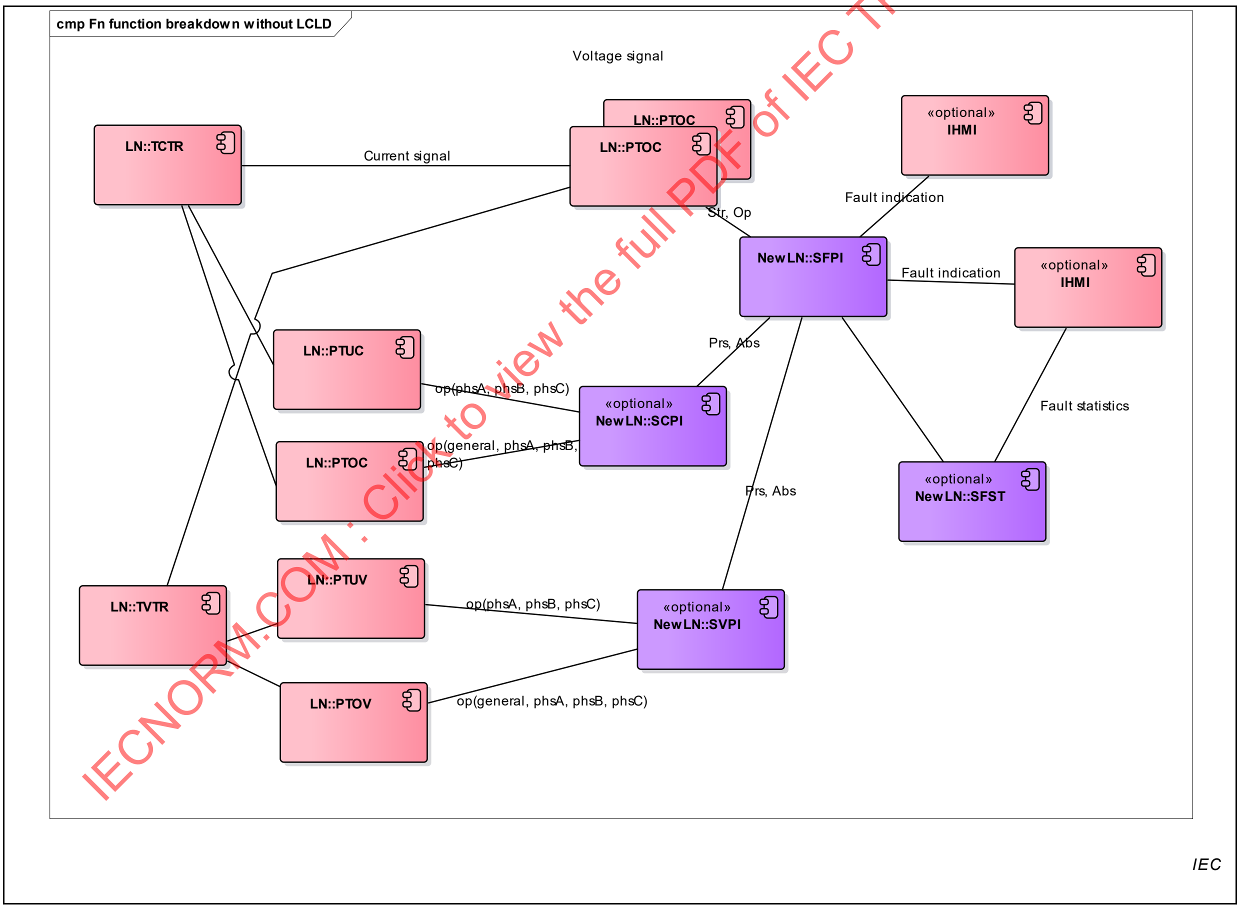
5.1.2.1 Mapping of required LN on LN classes

Requirement	IEC 61850 LN mapping
Time over-current detection May be phase current or earth current. May be directional	PTOC -> Time over-current “Protection” ***Or any P-type LN*** Provides transient signals of fault start with operation (confirmation) after a time delay Note: even if P node have been designed for protecting equipment, most of this nodes are currently only providing a fault signature detection, which is exactly what is expected here.
(per phase) Voltage under or over a threshold, within a given timing	PTUV, PTOV Provides (per phase) status (start) and transient signals needed to elaborate voltage presence and absence status.
(per phase) Current below or over a threshold, , within a given timing	PTUC, PTOC Provides (per phase) status (start) and transient signals needed to elaborate current presence and absence status
Fault indication e.g. phase fault or earth fault Computation of fault passage indication based on fault signature detection (P LN series) and SVPI and/or SCPI. Elaborate as well its type (transient, semi-permanent, permanent, etc)	SFPI New. In some ways, similar to PTRC, with two main differences: Semantic differences -> expected to provide an **indication** of fault and not a Trip Logic -> sort the faults per types
SVPI -> Voltage presence indicator function which produces a persistent “presence” signal and an “absence” signal based on inputs from PTOV, PTUV In general, Abc is set by PTUV.Op and is reset when PTUV.Str resets Prs is set by PTOV.Op and is reset when PTOV.Str resets It can be a stand-alone function, but may also be used (as depicted in the use cases above) for feeding the SFPI LN, by providing evidence that a detected fault was cleared and/or that supply has been restored. A SVPI logical node can also be used to provide the same common outputs to feed an automatic transfer between different sources.	SVPI New. Especially elaborate the presence and absence signals, from each of the 3 phases indications Presence and absence are not always opposed – there are some situations where none of the indicators could be true, depending on the choices of the thresholds.
SCPI -> Current presence indicator function which produces a persistent “presence” signal and an “absence signal” based on inputs from PTOC,PTUC This logical node is analogous to the SVPI for voltage presence, except that its inputs are based on PTOC and PTUC logical nodes configured for current detection.	SCPI New Presence and absence are not always opposed – there are some situations where none of the indicators could be true, depending on the choices of the thresholds. In addition SCPI presence will indicate per phase

Requirement	IEC 61850 LN mapping
	the direction of the power flow, based on the foreward/backward convention (as for protection)
SFST -> Computation statistics on fault presence for a given period.	SFST New Can benefit from the statistical model of IEC 61850 in order to provide nested statistics (average, max, min, max avg, min avg, max max, min min….)
Hosting a setting which will wire logically the Phase Current transformer to the right phase (avoiding rewiring the cubicle to get this match, and then saving time of the Field Operation Personel	LCLD is a new LN which intends to hold settings which are common to all the LNs present in this LD (note that LLN0 and LPHD can't be extended because currently don't host a namespace name to identify such extension)

5.1.2.2 Possible arrangement of LNs to support fault passage indication

Figure 26 shows a possible arrangement of LNs to support fault passage indication.



NOTE For an easier reading of the diagram, the common setting LN (LCLD) is not shown here.

Figure 26 – Possible arrangement of LNs to support fault passage indication

5.1.3 Mapping of the requirements of "other functions"

5.1.3.1 Mapping of the requirements of "Monitoring substation environment"

Not developped yet.

5.1.3.2 Mapping of the requirements of "Monitor external communication"

Not developped yet

5.1.3.3 Mapping of the requirements of "Energy flow related use cases"

5.1.3.3.1 Mapping of required LN on LN classes

The use cases under scope are defined in 4.4.4.

Requirement	61850 LN mapping
Hosting the sign convention which determines supply vs demand direction	LCLD is a new LN which intens to hold settings which are common to all the LNs present in this LD (see above)
Elaborate the direction supply/demand of the energy flow in real time	MMXU can be extended for this purpose
Provide Energy measurement for operation with reset capabilities	MMTR can be extended for this purpose (currently only hold BCR type measurement for revenue purpose)
Provide per quadrant Energy measurement for operation with reset capabilities	MMTR can be extended for this purpose

5.1.3.3.2 Possible arrangement of LNs to support "Energy flow related use cases"

Figure 27 shows a possible arrangement of Logical Nodes to fullfill the information exchange expressed in 4.4.4.

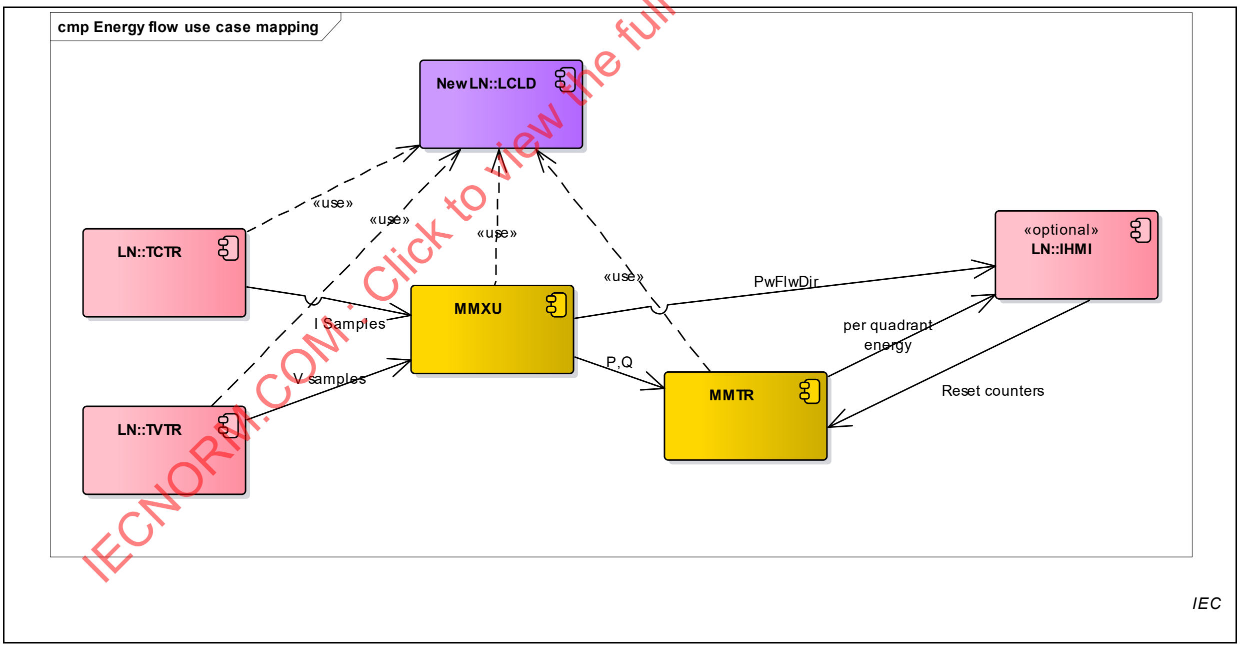


Figure 27 – Possible arrangement of LNs to support "Energy flow related use cases"

5.1.3.4 Mapping of the requirements of FLISR

Not developped yet.

5.1.3.5 Mapping of the requirements of VVC

Not developped yet.

5.1.3.6 Mapping of the requirements of distributed DER management

Not developped yet

5.1.4 Mapping of the requirements of "product life cycle" (FieldComp remote configuration)

5.1.4.1 Mapping of required LN on LN classes

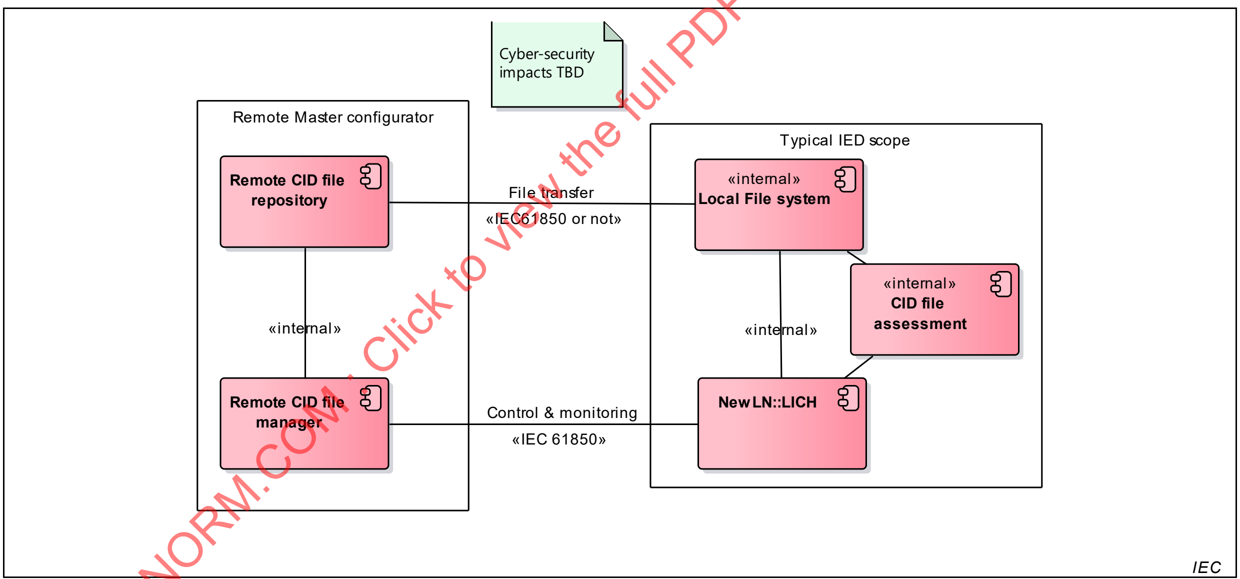
The use cases under scope are defined in 4.5.1.

Requirement	61850 LN mapping
Handling the state machine needed to support the remote configuration	LICH – FieldComp Configuration Handling New.

Elements and their interface needed to manage the local configuration file repository and the interface for loading such files, and checking their content is supposed to be outside of this document scope.

5.1.4.2 Possible arrangement of LNs to support FieldComp (remote) configuration

Figure 28 shows a possible arrangement of Logical Nodes to fullfill the information exchange expressed in 4.5.1.



NOTE The logic for determining the on/off pattern for an indicator lamp is vendor specific, i.e. outside the scope of this standardisation proposal.

Figure 28 – Possible arrangement of LNs to support CID Handling

6 Logical node classes

6.1 General

Clause 6 specifies logical nodes used to map the use cases considered in this document.

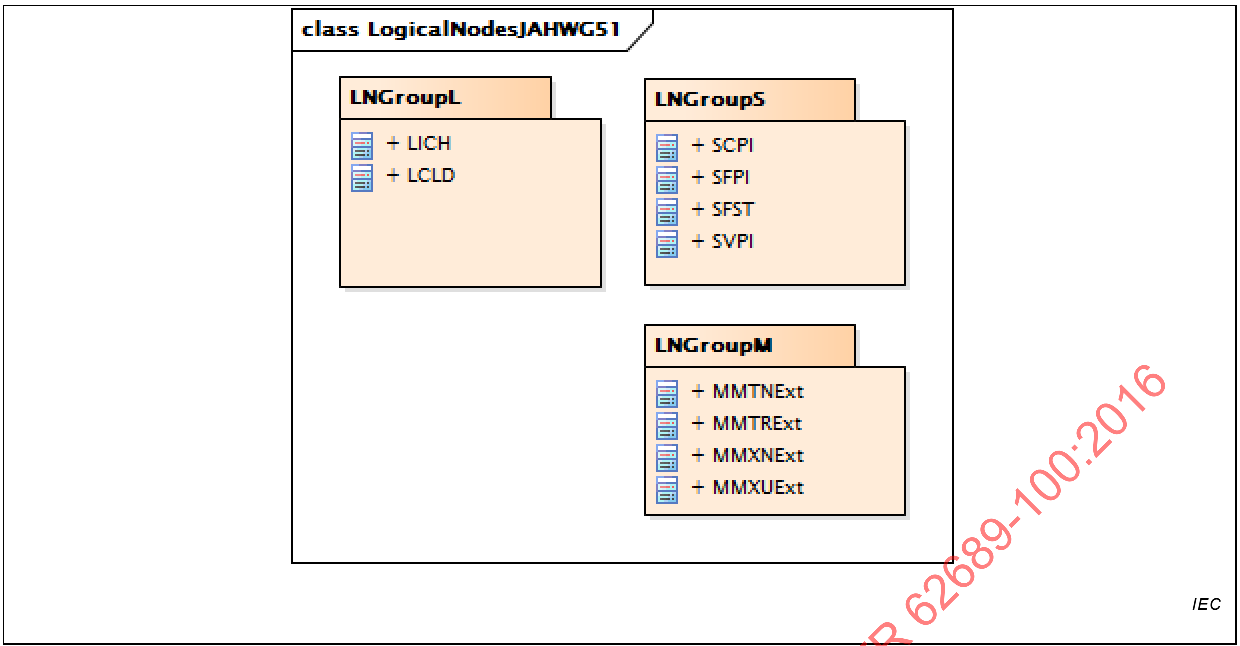


Figure 29 – Class diagram LogicalNodesJAHWG51::LogicalNodesJAHWG51

Figure 29: List of LNs included in the model extension proposal

All common data classes referenced below are refering to CDCs from IEC 61850-7-3.

6.2 Package LNGroupL

6.2.1 General

This set of LNs proposed extensions to existing IEC 61850 namespaces to support system specific information, as requested through the use cases defined in this document.

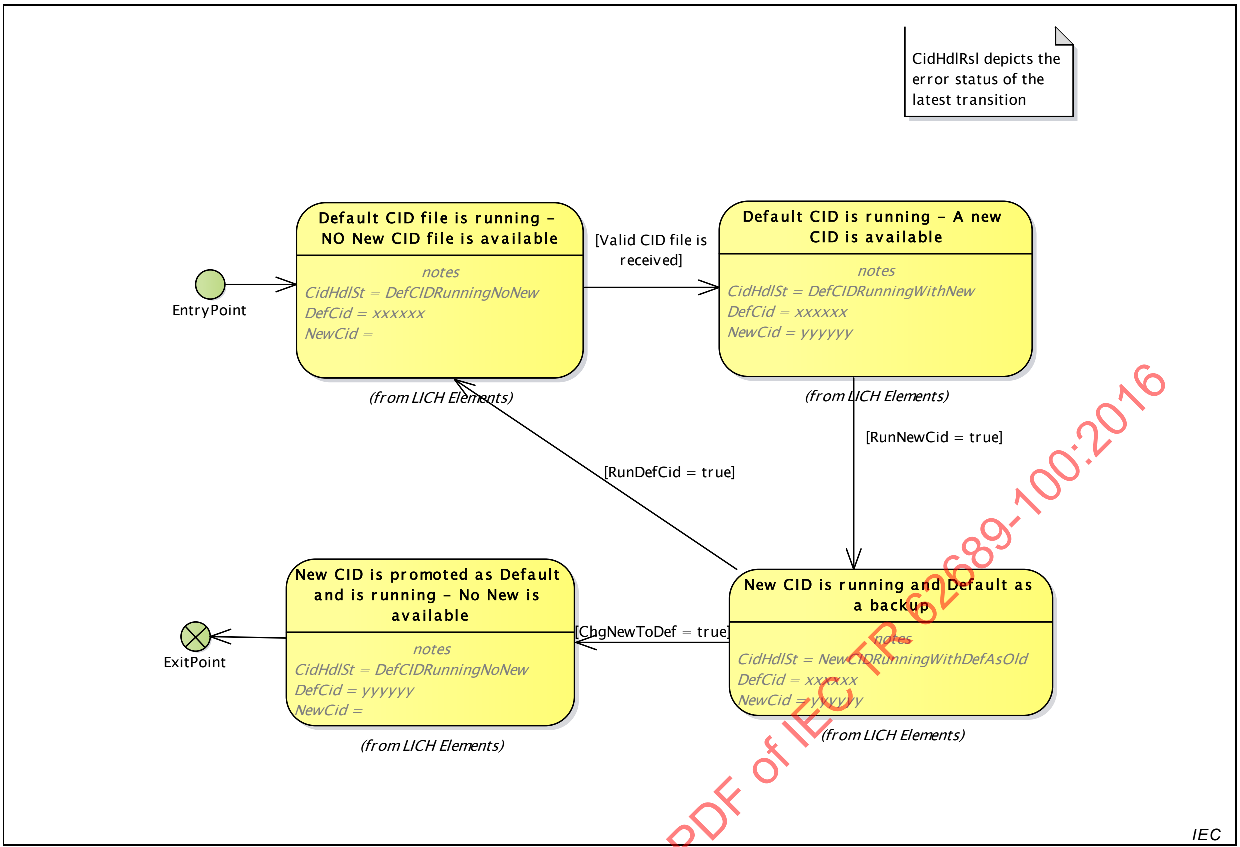


Figure 30 – Statechart diagram LNGroupL::LNGroupL

Figure 30: Use of LICH DOs to support the state machine of CID file handling

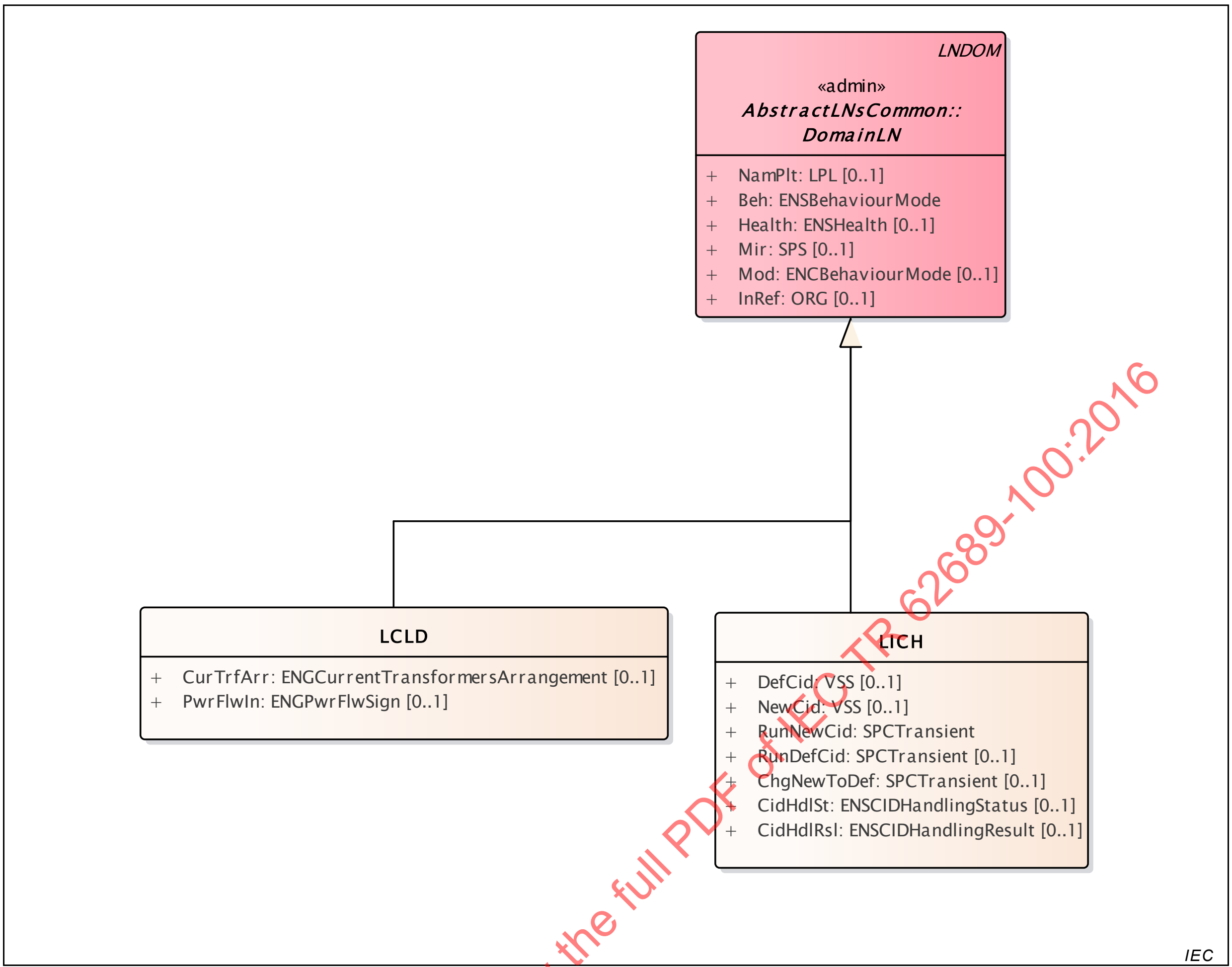


Figure 31 – Class diagram LNGroupL::LNGroupL

Figure 31: List of proposed new LNs to extend the Group L of LNs

6.2.2 LICH LN

IED (CID) Configuration file Handling

Table 6 shows all data objects of LICH.

Table 6 – Data objects of LICH

LICH				
Data object name	**Common data class**	**T**	**Explanation**	**PresCond nds/ds**
Descriptions				
NamPlt	LPL		inherited from: DomainLN	O / na
Status information				
DefCid	VSS		Default CID file name or identifier.	O / na
NewCid	VSS		New CID file name or identifier	O / na
CidHdlSt	ENS (CIDHandlingStatusKind)		Expose the status of the state machine related to the CID file handling.	O / na
CidHdlRsl	ENS (CIDHandlingResultKind)		Expose the result (successful or faulty, with the detail of the error which may have occurred) of the latest transition of the state machine related to the CID file handling.	O / na
Beh	ENS (BehaviourModeKind)		inherited from: DomainLN	M / na
Health	ENS (HealthKind)		inherited from: DomainLN	O / na
Mir	SPS		inherited from: DomainLN	MOcond(1) / na
Controls				
RunNewCid	SPC	T	(controllable) Operating with value true initiates the device to run with the new CID. Operating with value false is ignored. The change of its status value from true to false is a local issue and should not be reported	M / na
RunDefCid	SPC	T	(controllable) Operating with value true initiates the transition to force a device to run its default CID (often a way back to previous stage). Operating with value false is ignored. The change of its status value from true to false is a local issue and should not be reported	O / na
ChgNewToDef	SPC	T	(controllable) Operating with value true initiates the promotion of the new CID to become the default CID Operating with value false is ignored. The change of its status value from true to false is a local issue and should not be reported	O / na
Mod	ENC (BehaviourModeKind)		inherited from: DomainLN	O / na
Settings				
InRef	ORG		inherited from: DomainLN	Omulti / na

6.2.3 LN: Common LD Settings Name: LCLD

Common LD Settings

Table 7 shows all data objects of LCLD.

Table 7 – Data objects of LCLD

LCLD				
Data object name	**Common data class**	**T**	**Explanation**	**PresCond nds/ds**
Descriptions				
NamPlt	LPL		inherited from: DomainLN	O / na
Status information				
Beh	ENS (BehaviourModeKind)		inherited from: DomainLN	M / na
Health	ENS (HealthKind)		inherited from: DomainLN	O / na
Mir	SPS		inherited from: DomainLN	MOcond(1) / na
Controls				
Mod	ENC (BehaviourModeKind)		inherited from: DomainLN	O / na
Settings				
CurTrfArr	ENG (CurrentTransformersArrangementKind)		Sets CTs arrangement in order to make easier the installation of device	O / na
PwrFlwIn	ENG (PwrFlwSignKind)		Sets the power flow supply/demand convention. This setting will apply to all object information of all LNs contained in this LD, and using the backward/forward direction convention (may typically apply to P Group LNs, or S Nodes LNs)	O / na
InRef	ORG		inherited from: DomainLN	Omulti / na

6.3 Package LNGroupM

6.3.1 General

This group of logical nodes represents proposed extensions to existing IEC 61850 namespaces to support metering and measuring functions requested through the use cases defined in this document.