IEC 61850 – Is it for Protection or for SCADA Engineers?

Communication networks and systems for power utility automation

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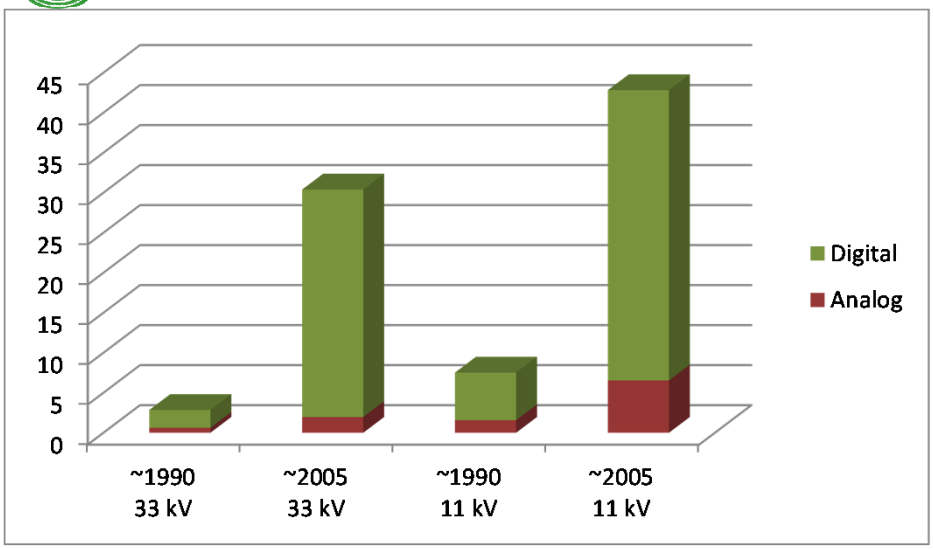
SCADA Point Count



A picture is worth a thousand words,
but sometimes you also need the right words

LN Group
P: Protection

PDIF	Differential
PDIR	Directional comparison
PDIS	Distance
PDOP	Directional over power
PDUP	Directional under power
PFRC	Rate of change of frequency
PHAR	Harmonic restraint
PHIZ	Ground detector
PIOC	Instantaneous over current
PMRI	Motor restart inhibit
PMSS	Motor starting time supervision
POPF	Over power factor
PPAM	Phase angle measuring
PRTR	Rotor protection
PSCH	Protection scheme
PSDE	Sensitive directional earthfault
PTEF	Transient earth fault
PTHF	Thyristor protection
PTOC	Time overcurrent
PTOF	Overfrequency
PTOV	Overvoltage
PTRC	Protection trip conditioning
PTTR	Thermal overload
PTUC	Undercurrent
PTUF	Underfrequency
PTUV	Undervoltage
PUPF	Underpower factor
PVOC	Voltage controlled time overcurrent
PVPH	Volts per Hz
PZSU	Zero speed or underspeed

R Group

RADR	Disturbance recorder channel analogue
RBDR	Disturbance recorder channel binary
RBRF	Breaker failure
RDIR	Directional element
RDRE	Disturbance recorder function
RDRS	Disturbance record handling
RFLO	Fault locator
RMXU	Differential measurements
RPSB	Power swing detection/blocking
RREC	Autoreclosing
RSYN	Synchronism-check

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IEC 61850 is an engineering system to configure devices to send pieces of structured information from “a” to “b”

LN Groups:
A: Automatic control
C: Supervisory control

ANCR	Automation: Neutral Current Regulator control
ARCO	Automation: Reactive power control
ARIS	Automation: Resistor control
ATCC	Automation: tap changer controller
AVCO	Automation: Voltage control

CALH	Control: Alarm handling
CCGR	Control: Cooling group control
CILO	Control: Interlocking
CPOW	Control: Point-on-wave switching
CSWI	Control: Switch controller
CSYN	Control: Synchronizer controller

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M Group

MENV	Environmental information
MFLK	Flicker measurement
MFLW	Flow measurements
MFUL	Fuel characteristics
MHAI	Harmonics or interharmonics
MHAN	Non-phase-related harmonics or interharmonics
MHET	Heat measured values
MHYD	Hydrological information
MMDC	DC measurement
MMET	Meteorological information
MMTN	Metering
MMTR	Metering
MMXN	Non-phase-related measurement
MMXU	Measurement
MPRS	Pressure measurements
MSQI	Sequence and imbalance
MSTA	Metering statistics

LN Group
F: Functional blocks
G: Generic function references

FCNT	Counter
FCSD	Curve Shap Description
FFIL	Generic filter
FLIM	Control function output limitation
FPID	PID regulator
FRMP	Ramp function
FSEQ	Sequencer
FSPT	Set-point control function
FXOT	Action at over threshold
FXUT	Action at under threshold

GAPC	Generic automatic process control
GGIO	Generic process I/O
GLOG	Generic log
GSAL	Generic security application

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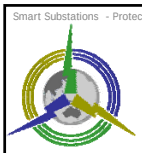
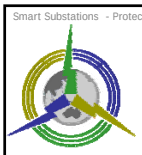


I, K, L group

IARC	Archiving
IHMI	Human machine interface
ISAF	Safety alarm function
ITCI	Telecontrol interface
ITMI	Telemonitoring interface
ITPC	Teleprotection communication interfaces

KFAN	Fan
KFIL	Filter
KPMP	Pump
KTNK	Tank
KVLV	Valve control

LCCH	Physical communication channel supervision
LGOS	GOOSE subscription
LLN0	Logical node zero
LPHD	Physical device information
LSVS	Sampled value subscription
LTIM	Time management
LTMS	Time master supervision
LTRK	Service tracking



Q Group

QFVR	Frequency variation
QITR	Current transient
QIUB	Current unbalance variation
QVTR	Voltage transient
QVUB	Voltage unbalance variation
QVVR	Voltage variation

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S Group

SARC	Monitoring and diagnostics for arcs
SCBR	Circuit breaker supervision
SIMG	Insulation medium supervision (gas)
SIML	Insulation medium supervision (liquid)
SLTC	Tap changer supervision
SOPM	Supervision of operating mechanism
SPDC	Monitoring and diagnostics for partial discharges
SPTR	Power transformer supervision
SSWI	Circuit switch supervision
STMP	Temperature supervision
SVBR	Vibration supervision

T Group

TANG	Angle
TAXD	Axial displacement
TCTR	Current transformer
TDST	Distance
TFLW	Liquid flow
TFRQ	Frequency
TGSN	Generic sensor
THUM	Humidity
TLEV	Level sensor
TLVL	Media level
TMGF	Magnetic field
TMVM	Movement sensor
TPOS	Position indicator
TPRS	Pressure sensor
TRTN	Rotation transmitter
TSND	Sound pressure sensor
TTMP	Temperature sensor
TTNS	Mechanical tension / stress
TVBR	Vibration sensor
TVTR	Voltage transformer
TWPH	Water acidity

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X and Y Group

XCBR	Circuit breaker
XFUS	Fuse
XSWI	Circuit switch

YEFN	Earth fault neutralizer (Petersen coil)
YLTC	Tap changer
YPSH	Power shunt
YPTR	Power transformer

Z Group

ZAXN	Auxiliary network
ZBAT	Battery
ZBSH	Bushing
ZBTC	Battery Charger
ZCAB	Power cable
ZCAP	Capacitor bank
ZCON	Converter
ZGEN	Generator
ZGIL	Gas insulated line
ZINV	Inverter
ZLIN	Power overhead line
ZMOT	Motor
ZRCT	Rectifier
ZREA	Reactor
ZRES	Resistor
ZRRC	Rotating reactive component
ZSAR	Surge arrestor
ZSCR	Semi-conductor controlled rectifier
ZSMC	Synchronous machine
ZTCF	Thyristor controlled frequency converter
ZTCR	Thyristor controlled reactive component

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W Group

WALG	Wind turbine analogue log information
WALM	Wind power plant alarm information
WAPC	Wind power plant active power control information
WCNV	Wind turbine converter information
WCON	Wind turbine condition monitoring information
WGEN	Wind turbine generator information
WMET	Wind power plant meteorological information
WNAC	Wind turbine nacelle information
WREP	Wind turbine report information
WROT	Wind turbine rotor information
WRPC	Wind power plant reactive power control information
WSLG	Wind turbine state log information
WTOW	Wind turbine tower information
WTRF	Wind turbine transformer information
WTRM	Wind turbine transmission information
WTUR	Wind turbine general information
WYAW	Wind turbine yawing information

LN Group
H: Hydro

HBRG	Turbine – generator shaft bearing
HCOM	Combinator
HDAM	Hydropower dam
HDLS	Dam leakage supervision
HGPI	Gate position indicator
HGTE	Dam gate
HITG	Intake gate
HJCL	Joint control
HLKG	Leakage supervision
HLVL	Water level indicator
HMBR	Mechanical brake
HNDL	Needle control
HNHD	Water net head data
HOTP	Dam over-topping protection
HRES	Hydropower/water reservoir
HSEQ	Hydropower unit sequencer
HSPD	Speed monitoring
HUNT	Hydropower unit
HWCL	Water control

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LN Group D: Distributed energy resources

DCCT	DER economic dispatch parameters
DCHB	Boiler
DCHC	CHP system controller
DCIP	Reciprocating engine
DCRP	DER plant corporate characteristics at the ECP
DCTS	Thermal storage
DEXC	Excitation
DFCL	Fuel cell controller
DFLV	Fuel delivery system
DFPM	Fuel processing module
DGEN	DER unit generator
DOPA	DER operational authority at the ECP
DOPM	Operating mode at ECP
DOPR	Operational characteristics at ECP
DPST	Status information at the ECP
DPVA	Photovoltaics array characteristics
DPVC	Photovoltaics array controller
DPVM	Photovoltaics module ratings
DRAT	DER generator ratings
DRAZ	DER advanced generator ratings
DRCC	DER supervisory control
DRCS	DER controller status
DRCT	DER controller characteristics
DREX	Excitation ratings
DSCC	DER energy and/or ancillary services schedule
DSCH	DER energy and/or ancillary services schedule
DSFC	Speed/Frequency controller
DSTK	Fuel cell stack

Distributed Energy Resources

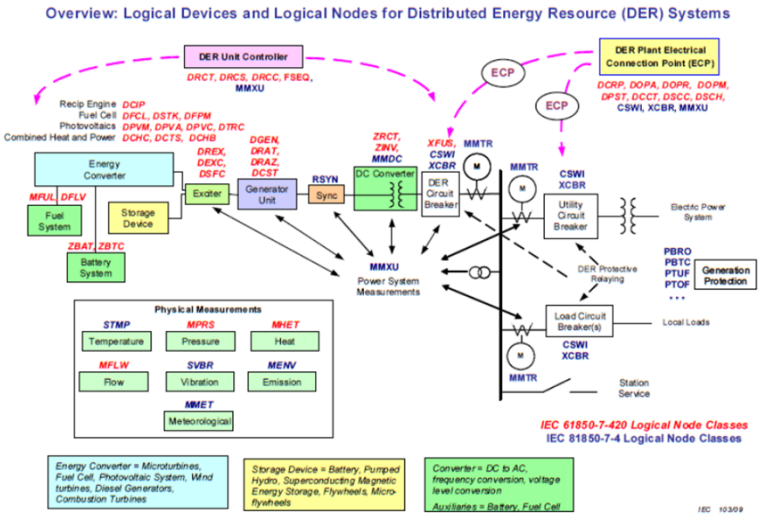

Figure 5 – Overview: Conceptual organization of DER logical devices and logical nodes

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Volume of Condition Monitoring Engineering

	SCADA, DMS, EMS	Substation Automation	Asset Management
Number of points acquired from Condition Monitoring Device IEDs	Small	Small to medium	Large
Type of system processing	Continuous	Continuous	Batch or continuous
Type of data acquisition	Online, real-time	Online, real-time	• Deferred time-series acquisition • Manual entry • Online • Real Time
Source of information	SA, IEDs, primary equipment	IEDs, primary equipment	IEDs, primary equipment, offline test reports, SCADA, DMS, EMS, SA, Historian, ERP systems

IEC 61850 90-3 Condition Monitoring

- Gas Insulated Switchgear
- Transformer
- Tap Changer
- Underground Cables
- Transmission Lines
- Auxiliary Power systems

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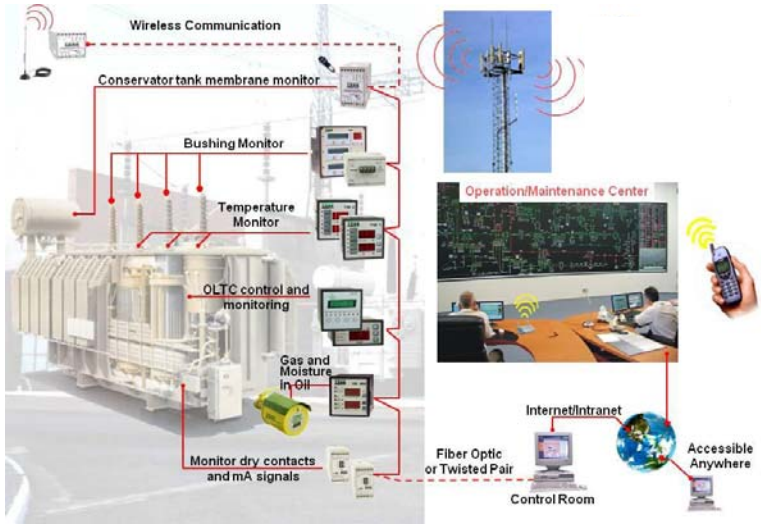
Transformer Sensors

Dissolved gas sensor	Bushing leakage current	Relative humidity (RH) sensor
Bushing voltage sensor	Oil temp sensor at RH sensor	Ambient temp sensor
Partial discharge sensor	Cooling bank status sensor	Direct winding temp sensor
Pump/fan current sensor	Load current sensor	Buchholz relay
Top oil temp sensor	Oil level sensor	Bottom oil temp
Pressure sensor	Winding hot spot temp	Conservator membrane rupture



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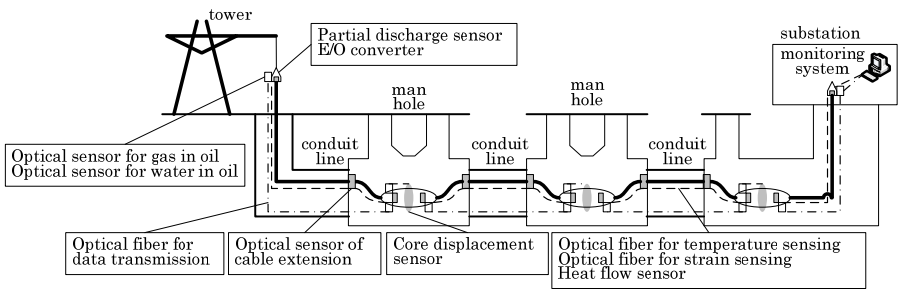
Transformer LN Data Objects

Logical Node	Description	Status	Measured Values	Controls	Settings
SIML	Supervision Insulation medium (liquid)	30	19	1	22
SPDC	Monitoring and diagnostics for partial discharges	2	4	1	2
SPTR	Power Transformer Supervision	6	4	1	
SIMA	Supervision Insulation moisture and aging (solid)	3	11	1	
SBTP	Bubbling temperature supervision	3	11	1	
ZBSH	Bushing	2	6		3
CCGR	Cooling group control	4	10	7	1

Under Ground Cable



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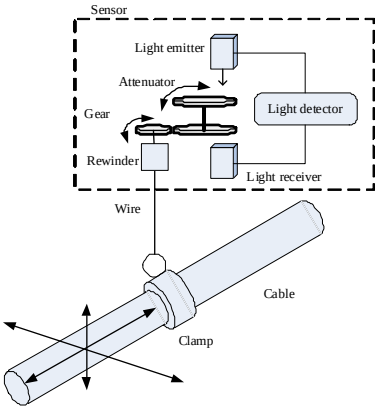
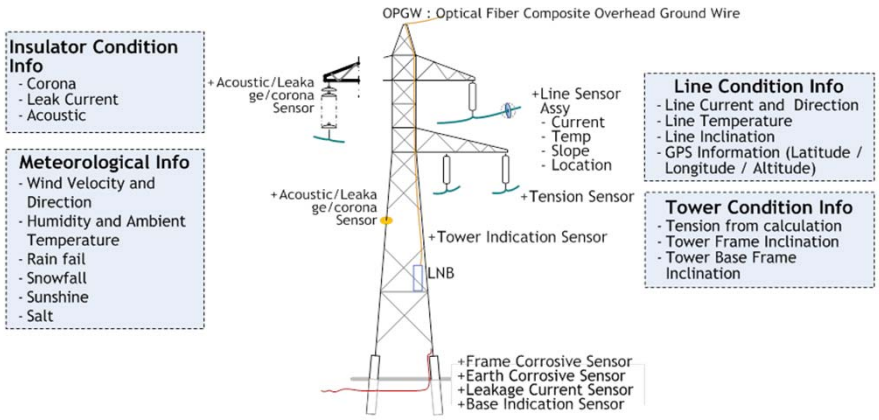
Cable Displacement >> Cracking



Transmission Lines



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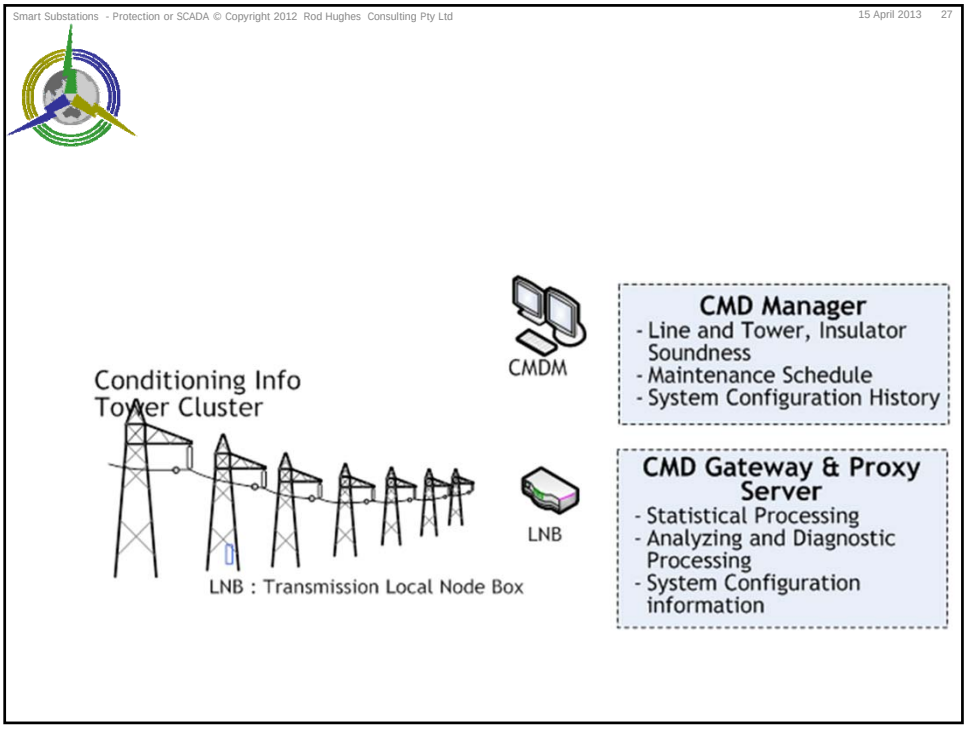
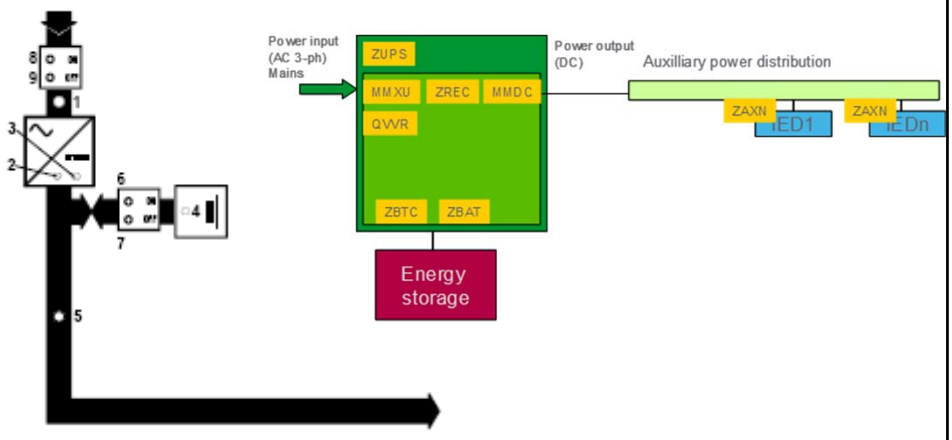


Secured DC system

AC input power



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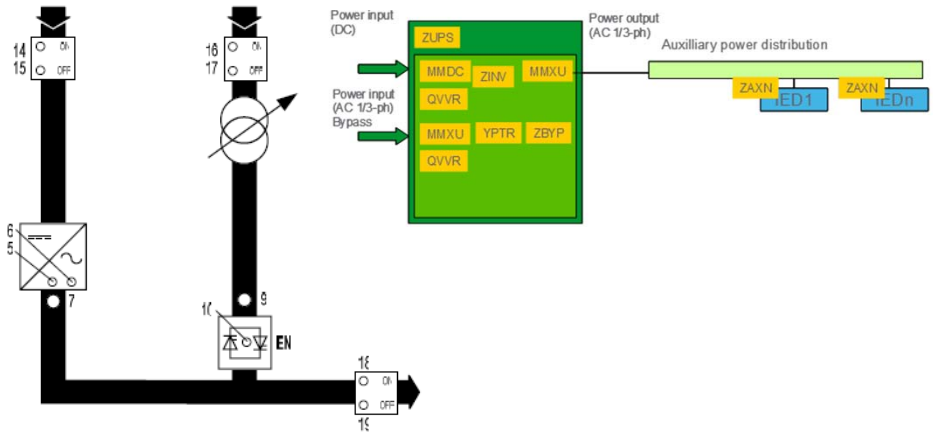
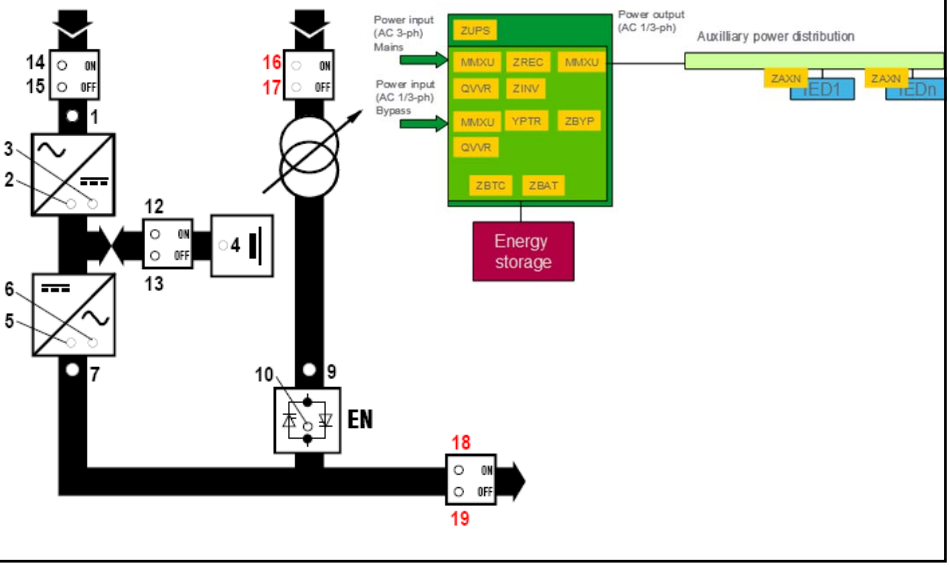
Secured AC system
DC input, AC backup



Secured AC system
AC input, AC backup



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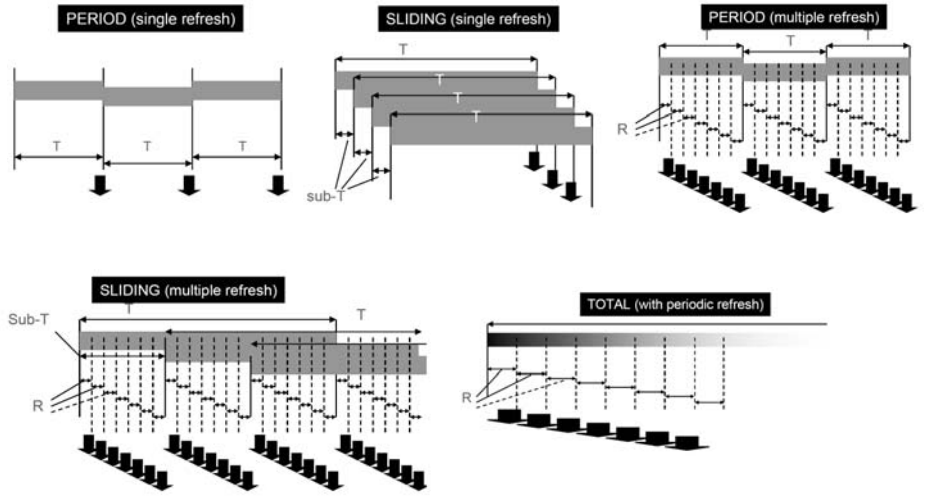
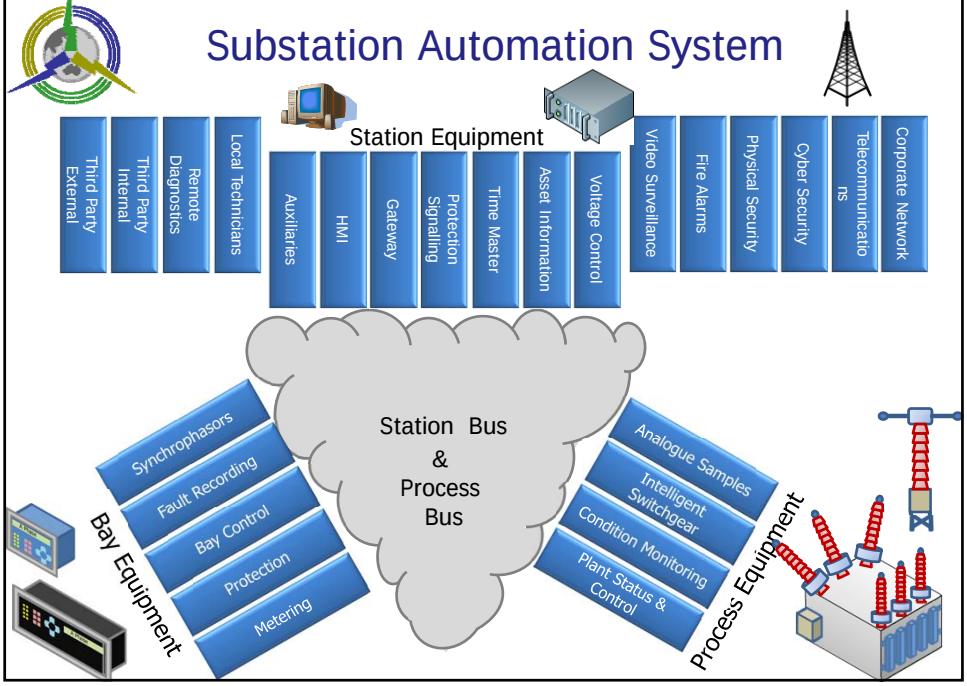
Statistical Treatment



Substation Automation System



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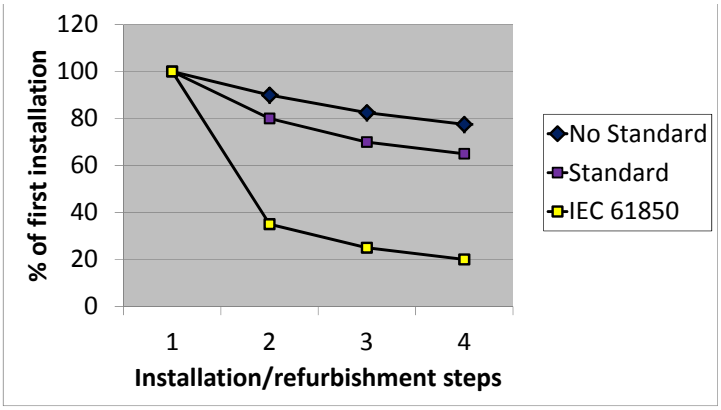
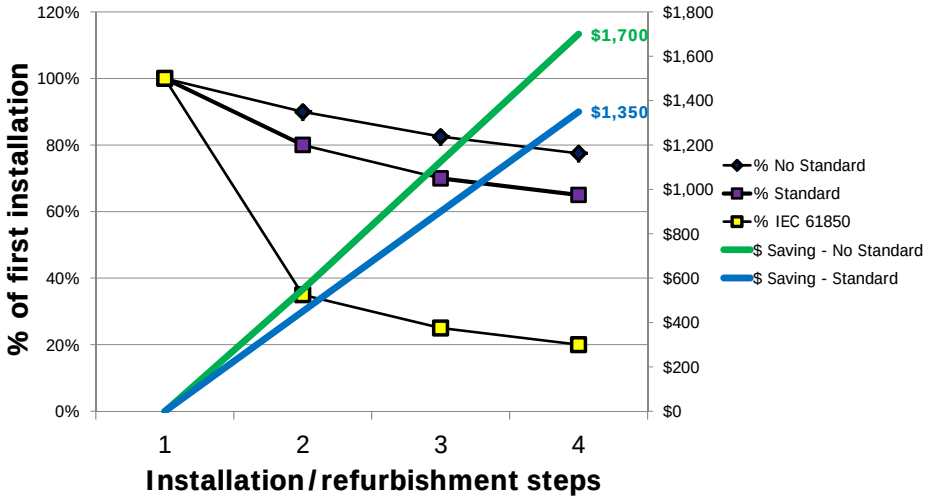
Lifetime Cost Slashing

- "The Impact of the coming Standard IEC 61850 on the Life-cycle of Open Communication Systems"
  - Distribution 2001, Brisbane: ABB



Return On Investment



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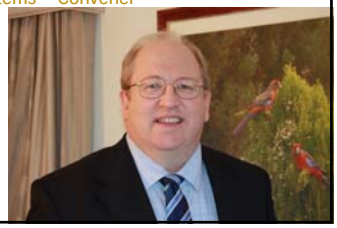
Skills, Process, Ultimate Objective

- multiple engineers
- in multiple departments
- in multiple organisations
- over multiple phases
- in multiple primary and secondary projects
- coherently deployed over the next 100 years
- incorporating hundreds of functions,
- dozens of different IED box types
- from dozens of different vendors
- to enhance reliability, reduce risks and provides Reusable Engineering.

Rod Hughes

- 30 years in protection engineering
  - GEC, ALSTOM: P&C Engineer, Engineering Manager, General Manager – Australia
  - ALSTOM: P&C Product Director - France
  - ElectraNet: Protection & Telecoms Manager, Plant Strategy & Technology Manager
  - SKM: State Manager - South Australia
  - AECOM: Technical Director - South Australia
  - **Rod Hughes Consulting Pty Ltd: Managing Director & owner**
- CIGRE
  - AP B5 Protection & Automation 1985 - 1998, 2001- current
    - (Convener since 2004)
  - AP D2 2001 – 2004 Information & Telecommunications
  - Technical Brochure 326 Implementation of IEC 61850
  - WG B5-39 Documentation for Digital Substation Automation Systems – Convener
  - South East Asia Protection & Automation Conference
- UCA® International Users Group
- IEEE Power Engineering Society
- Publications and Technical Papers
- Training courses – Protection & IEC 61850
- LinkedIn forum
- Owner IEC 61850 Patent: Operator & Test Interface



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- IEC 61850 and associated standards
- Automation & Control
- Protection design 11kV to 500kV
- Training
- Cyber Security
- Smart Grid and Smart Metering
- Telecommunications
- Substation LAN

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