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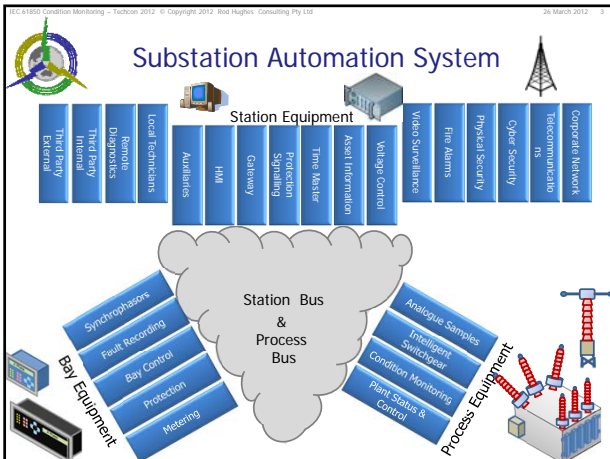
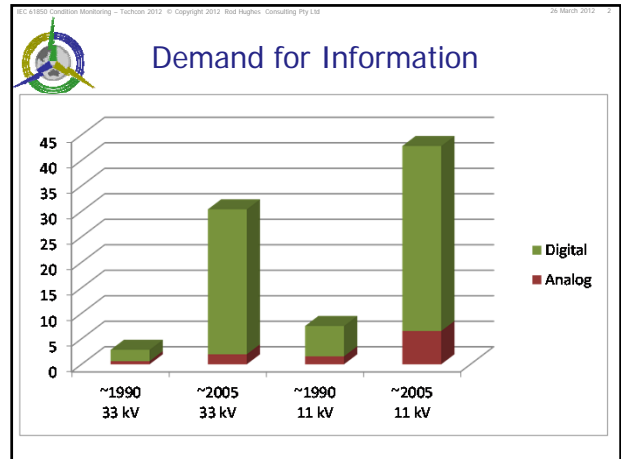


## State Of The Art Asset Condition Monitoring Systems with IEC 61850


### IEC 61850-90-3

#### "Using IEC 61850 for Condition Monitoring Diagnosis and Analysis"

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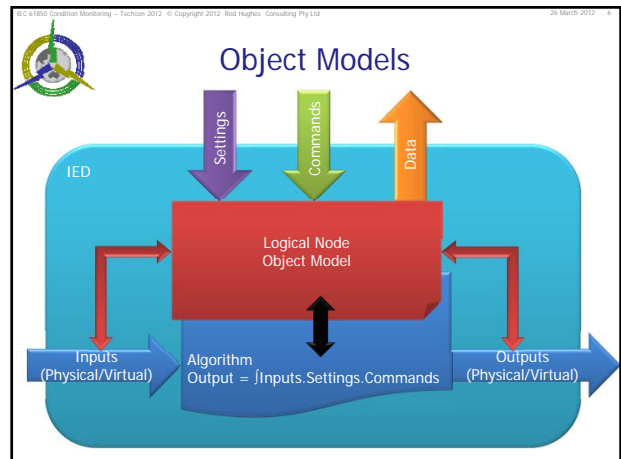
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## System Requirements

	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	<ul style="list-style-type: none"> <li>Deferred time-series acquisition</li> <li>Manual entry</li> <li>Online</li> <li>Real Time</li> </ul>
Source of information	SA, IEDs, primary equipment	IEDs, primary equipment	IEDs, primary equipment, offline test reports, SCADA, DMS, EMS, SA, Historian, ERP systems

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- 
- ## The Standard
- IEC 61850-6 engineering process and file structure
    - \* design office (i.e. instead of "Autocad", "Word" and "Excel") – System Configuration Language (SCL)
  - IEC 61850-7 IED data structure and naming
    - \* Logical Nodes, Data Objects and Attributes
  - IEC 61850-8 and IEC 61850-9 message and command formats
    - \* Reports, commands, Sampled Values, GOOSE, - Abstract Communication Services Interface (ACSI)



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



## 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

Extract IEC 61850-90-3

## Transformer Sensing

Courtesy Martec Asset Solutions & Tretech

## Transformer Logical Node 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

## Definitions on the Web

- The ability of information systems to operate in conjunction with each other encompassing communication protocols, hardware software, application, and data compatibility layers..
  - [www.ichnet.org/glossary.htm](http://www.ichnet.org/glossary.htm)
- the ability of one computer system to control another, even though the two systems are made by different manufacturers.
  - [www.sunrise-comp.co.uk/glossary.html](http://www.sunrise-comp.co.uk/glossary.html)
- This refers to the ability of a system or a product to work with other systems or products without special effort on the part of the customer ...
  - [www.michigandtv.com/glossary](http://www.michigandtv.com/glossary)
- The ability of any two computers that are interconnected to understand each other and perform mutually supportive tasks such as client/server computing
  - [www.nitrd.gov/pubs/bluebooks/1995/section.5.html](http://www.nitrd.gov/pubs/bluebooks/1995/section.5.html)

## Standardised Information

Attribute	Type	Value range	Mandatory/Optional/Conditional
stVal	BOOLEAN	TRUE   FALSE	M
q	Quality		M
t	TimeStamp		M

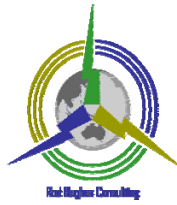
*SIML.TmpAlm.stVal* is ALWAYS whether the Alarm is on (True) or off (False).

*SIML.TmpAlm.q* is ALWAYS the quality of stVal, its source (real process or substituted value) and validity.

*SIML.TmpAlm.t* is ALWAYS the time when the value changed at its source (not the scan time of a RTU).

## Sample Certificates

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but sometimes you also need the right words



### Interoperability Nuts & Bolts

- 10mm nut, 8mm bolt are not interoperable
- Length
- Left / right hand thread
- Head
  - Spanner: Hex / square
  - Screwdriver: Phillips/flat
- Tensile strength
  - Steel/copper ...
- Galvanised/painted
- Shank/ full thread
- Lock nut
- Use with washer?
  - Flat, spring, internal star, external star

### Buy a tyre....

### System Interoperability

### Accessing Condition Monitoring Data

IEC 61850-7-2      IEC 64300

### Engineering Interoperability

- Front Plate
- Buttons
- Lights
- Menu
- I/O Allocation
- Scheme Logic

### Engineering Files IEC 61850-6

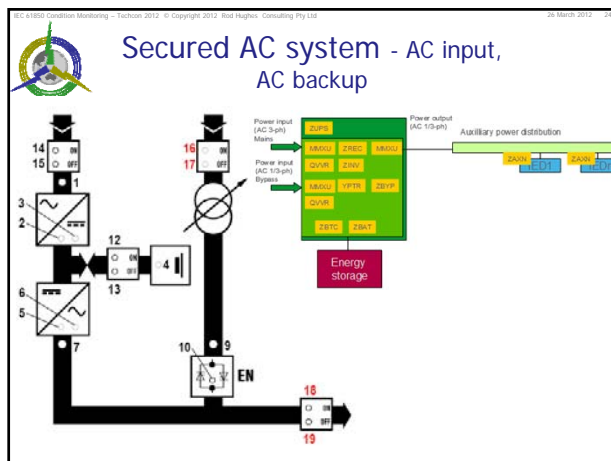
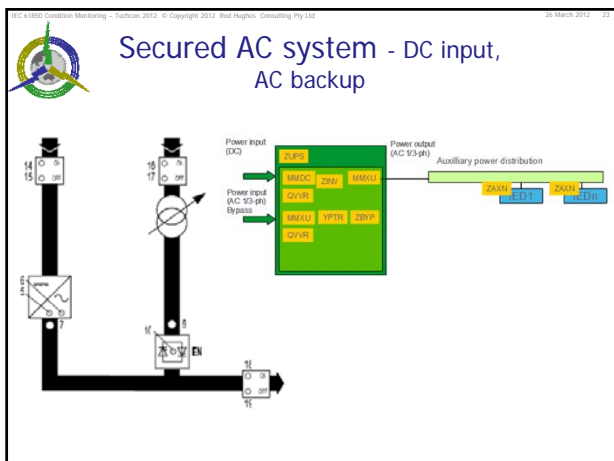
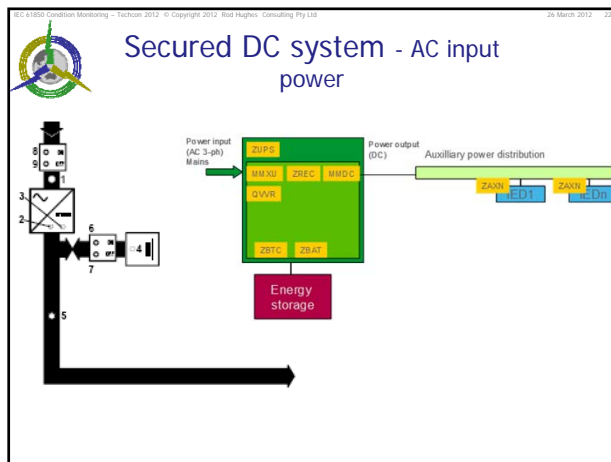
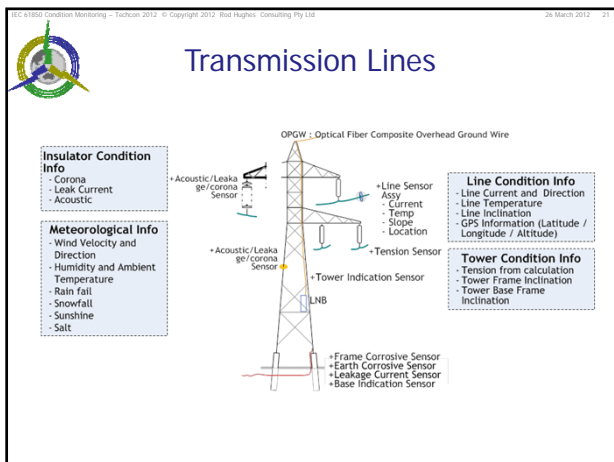
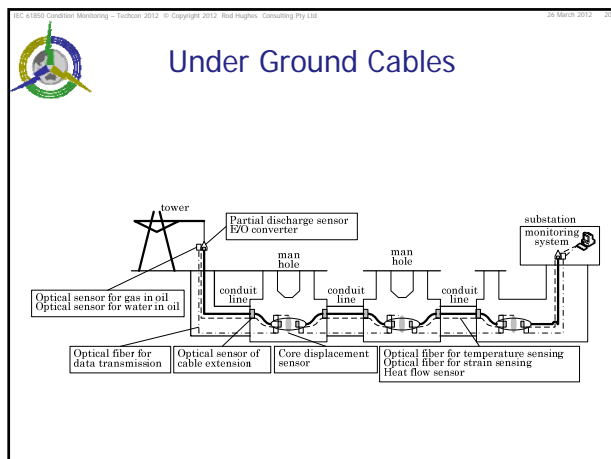
IED Related	System Specification Configuration Related
<b>ICD</b> IED Capability Description	<b>SSD</b> System Specification Description
<b>CID</b> Configured IED Description	<b>SCD</b> System Configuration Description
<b>IID</b> Instantiated IED Description	<b>SED</b> System Exchange Description

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IEC 61850-90-3


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



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## Condition Monitoring Using IEC 61850

- ✦ Increased demand for asset reliability
- ✦ Increased demand for information
- ✦ Increased range of devices
- ✦ Increased communication
- ✦ Increased integration
- ✦ Increased engineering interfaces
- ✦ Increased engineering efficiency
- ✦ Increased reusable engineering

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## 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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