T49 - Integration of Power Protection Devices on IEC 61850 Protocol to the Automation Control System
Agenda

- Electrical and Process Automation Systems
- What is Packaged Power
- Legacy ESCADA Systems
- IEC 61850
- Integration to Logix
The electrical distribution and infrastructure systems of heavy industry applications are not very well understood

- Need an easy way to gather information to maximize process yield and efficiency
- Need to improve industrial automation and control systems to better understand the “big picture” of heavy industry applications
Customers and EPCs prefer IMC content bundled with electrical system

Increasingly RA is bundled out

Technology convergence driving adoption of digital communication in electrical sub-stations and switchgear

A broader electrical bundle with technology differentiation enables success for RA in Power Control and Process Automation
Packaged Power
Connecting the Electrical Automation & Process Automation Systems

- Intelligent Electrical Devices (IEDs)
- IEC 61850 on unmodified Ethernet
- Electrical Automation Specialists (Protection Studies)

- Intelligent Motor Control (IMC) devices
- EtherNet/IP on unmodified Ethernet
- Automation Specialists (Network Studies)
Legacy E-SCADA Methodology

- E-SCADA Definition
- Various levels of control
  - Station
  - Bay
  - Process

![Diagram showing various levels of control and protocols](image)
Legacy SCADA Methodology

- Hardwired Discrete I/O
- Modbus-TCP
  - Master-Slave model
  - Ease of Implementation
  - Static Data only
  - No elegant timestamp data for SoE
  - No uniform data mapping

- DNP 3.0 LAN/WAN
  - Uses multi-drop configurations
  - Uses Master-Slave Model
    - Can be enhanced with data concentrators
  - Millisecond timestamp resolution
  - No uniform data mapping
Graphical Modbus TCP Example

What’s in register 3004?

Phase A Voltage
Real Power
Frequency

IED Network
SCADA Controller
Packaged Power
Intelligent Packaged Power Technical Strategy - Why IEC 61850

- Runs on unmodified Ethernet
- Vendor Independent
  - Unified data mapping
- High Precision Time stamping
- Mechanisms for
  - SCADA messaging
    - Metering/Measurement
  - Protection messaging
  - Time distribution
  - Command and Control
Packaged Power
Intelligent Packaged Power Technical Strategy - IEC 61850 Defined

- Object Oriented
- Communication Networks and Systems in Substations
- Focus on communication standardization
- Application and function aware
Packaged Power
Intelligent Packaged Power Technical Strategy - IEC 61850 Defined

- For Intelligent Electronic Devices (IEDs)
  - Protection relays, meters, etc.
- Defines various different types of messages
  - SCADA/HMI data – MMS Reporting
  - High Speed Control – GOOSE
  - Analog Sampling – SMV
  - File Transfer – FTP
  - Time Synchronization – IRIG; evolving to IEEE 1588 v.2
Packaged Power
Segmented Network Approach
Packaged Power
Segmented Network Approach

Enterprise-wide Business Systems

Plant-wide Site-wide Operation Systems

EtherNet/IP

Process Automation System Zone #1

Process Automation System Zone #2

Electrical Distribution Power Room

LV MCC

MV MCC

LV Switchgear

Levels 4 & 5 - Data Center Enterprise Zone

Level 3.5 - IDMZ

Level 3 - Site Operations Industrial Zone

Levels 0-2 Cell/Area Zones
Packaged Power
Segmented Network Approach → Integrated Network Approach

Enterprise-wide Business Systems

Plant-wide Site-wide Operation Systems

EtherNet/IP

Process Automation System Zone #1

Process Automation System Zone #2

Electrical Distribution Power Room

LV MCC

MV MCC

LV Switchgear

IEC 61850

IEC 61850

Levels 4 & 5 - Data Center Enterprise Zone

Level 3.5 - IDMZ

Level 3 - Site Operations Industrial Zone

Levels 0-2 Cell/Area Zones
Intelligent Packaged Power Technology
Unified Architecture Model

- **ISA 95**
  - Process Automation

- **IEC 61850**
  - Digital Substation

- **Unified Architecture**

  - **Unified Model**
    - Combined Power and Process
    - Create opportunity to drive differentiation within IPP

- **Same Solution; Different Models**
  - I&C Engineer resonates with ISA 95
  - Power Engineer resonates with substation model
Integrating intelligent devices in the Electrical Automation System to the Process Control System enables our customers in their efforts to achieve a Connected Enterprise.
Packaged Power
Extending The Connected Enterprise to the Electrical System

Single communication and control infrastructure for Electrical and Automation Systems

- EtherNet/IP and IEC 61850 standard over unmodified Ethernet
- Electrical substation monitoring and control added to the Logix control architecture
- Synchronization of facility wide data on the same clock to provide high accuracy time stamping

Value Proposition

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<tr>
<th>Increase Process Efficiency and Throughput</th>
<th>Integrated Energy Management and Control</th>
<th>Predictive and Preventive Diagnostics</th>
<th>Intelligent Safety</th>
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Benefit

- Timely availability of Intelligent Electrical Device (IED) data allowing for monitoring & control
- Faster reaction time to Electrical Supply & Process conditions
- Enhances ability to anticipate Process and Production conditions
- Limits exposed energy during arc flash events

Application examples

- Coarse Crusher Arc Furnace
- Arc Flash Detection
- Demand Load Shedding Facility Load Flow
- Web Handling

- Faster Time to Market
- Lower Total Cost of Ownership
- Improved Asset Utilization
- Enterprise Risk Management
Emax 2 Integration to Logix
Enhanced EDS AOP
Emax 2 Integration to Logix
Enhanced EDS AOP

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The values displayed here are read directly from the module. These values are not stored in the controller and are not sent to the module when a connection is established. Click Set to write updated values to the module.
Visualization Experience
PlantPAx Experience
Visualization Experience
IMC Devices
Visualization Experience
Electrical Automation System Devices

- Enabled
- Any Trip
- Any Warning
- Any Alarm
- Ready to Close
- Remote Mode
- CB In Test

Waiting for Alarm Events...

MAXX2 EtherNet/IP

Enabled

Wink:  Wink Active

Breaker Closed

Breaker Open

Phase Currents (A)

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Phase Voltage (V)

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Real Power (kW)

0.26

Reactive Power (kVar)

0.15

Apparent Power (kVA)

3.3

Phase-to-Phase Voltage

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pf: 0.79

Frequency: 60

Residual Volt: 0

Residual Cur: 0

Trips

- L Trip
- S Trip
- I Trip
- G Trip
- Inst. Trip
- IU Trip
- Simulated Trip
- UV Trip
- OUV Trip
- S2 Trip
- Gext Trip
- D Trip
- T Trip
- RV Trip
- RP Trip

(Continued on the next page)
Visualization Experience
Electrical Automation System Devices

SEL 751A IEC 61850

Waiting for Alarm Events...

- Enabled
- Trip
- Instantaneous
- Phase Overcurrent
- Ground Neutral Overcurrent
- Negative Sequence Overcurrent
- Over/Under Frequency
- Breaker Failure

Phase Currents (Amps)
- Phase A: 0
- Phase B: 0
- Phase C: 0
- Neutral: 0

Phase Voltages (kV)
- Phase A: 0
- Phase B: 0
- Phase C: 0
- Neutral: 45

Real Power (kW)
- 0

Reactive Power (kVar)
- 0

Apparent Power (kVA)
- 0

Phase-to-Phase Voltages
- Volts A-B (kV): 0
- Volts B-C (kV): 0
- Volts C-A (kV): 0

pf
- 1.000

Frequency
- 60

Residual Volt
- 0

ResidualCurr
- 0

Targets
- Phase Undervoltage Trip 1
- Phase Undervoltage Trip 2
- Loss Of Potential
- Phase Overvoltage Trip 1
- Phase Overvoltage Trip 2
- Power Factor Alarm
- Power Factor Trip
- Output of Trip Logic
- Circuit Breaker Opened
- Control Switch Opened

(continued on the next page)
Visualization Experience
EtherNet/IP vs. IEC 61850

Emax2 EtherNet/IP

- Enabled
- Any Trip
- Any Warning
- Any Alarm
- Any Timing
- Ready to Close
- Remote Mode
- CB in Test

Waiting for Alarm Events...

Emax2 IEC 61850

- Enabled
- Any Trip
- Any Warning
- Any Alarm
- Any Timing
- Ready to Close
- Remote Mode
- CB in Test

Waiting for Alarm Events...
End to End Reporting
VantagePoint Model
End to End Reporting

Dashboards

Main Circuit Breaker

- Any Trip
- Any Warning
- Any Alarm
- Any Timing
- CB Closed
- CB Open

Voltages
- L1: 473.7
- L2: 462.2
- L3: 466.2

Currents
- Real: 599.8
- Reactive: 599.5
- Apparent: 598.2

Powers
- 44.2
- 23.87
- 48.04

Frequency
- 60.00

Power Factor (PF)
- 0.808
# End to End Reporting

## Tabular Reports

### Main Circuit Breaker Last 8 Hours

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**Report Generated:** 2016-02-12 07:50:00

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<td>2016-02-12 07:35:00</td>
<td>323.62</td>
<td>287.45</td>
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<td>365.11</td>
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<td>313.31</td>
<td>59.84</td>
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</table>
End to End Reporting
Graphical Reports

Voltage vs Current All Phases for: Main Circuit Breaker
Report Period: 2016-02-11 23:50:52 To 2016-02-12 07:50:53
Report Generated: 2016-02-12 07:50:53
End to End Reporting
Real Time Trending
End to End Reporting
Real Time Trending
End to End Reporting
Real Time Trending
Power and Process Trending
Increased Visibility with Modeling

Rockwell SAGD: Fort McMurray, WellPad 1

<table>
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<th>Well in Test:</th>
<th>0.01</th>
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<tr>
<td>Elapsed Time:</td>
<td>75.07</td>
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<tr>
<td>Oil (m³):</td>
<td>49.93</td>
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<tr>
<td>Water (m³):</td>
<td>29.14</td>
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<tr>
<td>Gas (m³):</td>
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<td>Active Producing Wells</td>
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</tbody>
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Fort McMurray Energy Cost for Pump: Pump_701
Report Generated: 2016-07-20 17:21:54
Packaged Power
Intelligent Packaged Power Technical Strategy

EDS AOP

Faceplates

VantagePoint Dashboard
Thank You!