Experion’s Integrated Electrical Automation Solution with IEC 61850

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Introductions

Steven Mouncey

- Steve is a senior software engineer at Powell UK.
- He has worked on several large power management systems for the oil and gas industry and has been heavily involved in integrating IEC61850 into the Powell power management and electrical monitoring system.
- He is in the process of delivering one of Powell largest IEC61850 based solutions for BP on the Shah Deniz phase 2 project.
- Steve has worked for Powell UK for 13 years.

Peter Overgaauw

- Peter works for Honeywell as a Solution Consultant
- He is currently providing technical & project execution consultancy support to a number of Honeywell’s strategic corporate account customers
- He has more than 27 years of experience in the process control & automation industry
Abstract

• In this session ...
  – Gain a basic understanding of an electrical control management system
  – Exposure to a number of technology enablers
    • IEC 61850
    • IEDs (Intelligent Electronic Device)
  – Be introduced to the value & benefits of an integrated process control & electrical automation system
  – Understand how integrated electrical automation can be achieved using your Experion PKS system
Introduction

• The power system is the ‘lifeblood’ of the whole plant and therefore it must be predictable, provide high availability and reliability
Electrical Control System - Terminology

- ECMS – Electrical Control & Monitoring System
- ECMS – Electrical Control & Management System
- PMS – Power Management System
- SAS – Substation Automation System
- PMCS - Power Monitoring & Control System
- ENMCS - Electrical Network Monitoring & Control System

Today These Terms are Used Synonymously
ECMS - Description

- ECMS is typically divided into 4 main categories:
  - Supervisory control & data acquisition (SCADA)
  - Power generation control / power management (PMS)
  - Electrical Substation Automation - distribution & feeder automation (SAS)
  - Engineering & Maintenance Workstation & Tools
ECMS - Description

• Supervisory Control & Data Acquisition (SCADA)
  – Single line custom displays
  – Real-time monitoring & access to electrical system alarms / events
  – Troubleshooting analysis tools

• Power Generation Control / Power Management (PMS)
  – Power generation from turbine generators
  – Power generation optimization / economic fuel consumption management
  – Active & reactive power control, auto-synchronizing
  – Multiple generators load sharing management
  – Operational set point control for generators
  – Transformer load tap changer

• Electrical Substation Automation - Distribution & Feeder Automation (SAS)
  – Breaker operation & control
  – Load shedding / Load restoration
  – Multiple power source synchronization

• Engineering & Maintenance Workstation & Tools
  – Engineering tools for management / maintenance / troubleshooting of plant electrical protection & control devices
# Powering the Process

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<th>SAS (Substation)</th>
<th>Process System</th>
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<td>Power Grid</td>
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<td><strong>Protection &amp; Control IEDs</strong></td>
<td><strong>ICSS</strong> Power Subscriber to Support the Process</td>
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<td>Turbine Generator</td>
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<td>ECMS</td>
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<td>Supply - Power Generation, Management &amp; Distribution</td>
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**Supplying Power to Process Assets**
Traditional Approach to Electrical Control & Management

- Power generation & management has been around for decades
- Manual / labour intensive systems
- Inter relay signal hardwiring
- Normally a separate system – process vs. electrical control
- Separate SCADA & Event Historian requiring additional integration into PCS & with business systems
- Engineering & Maintenance of multiple 3rd Party Systems
- Multiple bus based protocols & hard wiring for controls & interlocks
- Serial links to electrical protection devices
- Represent this data on the operator display
- Limited / access view to the information available in the equipment
ECMS – Modern Day Approach

• ECMS – SCADA, PMS, SAS

Supervisory / HMI Server

ECMS / ICSS sharing a common infrastructure

PLC

Remote IO

Turbine Control Panel

ASDS Control Panel

HVAC Control Panel DSM

HVAC Control Panel DEM

Remote IO

Turbine Unit Control Panel DEM

Remote IO

Diesel Control Panel DSM

Relay

Relay

Relay

Relay

Ethernet

Analog / Digital

Hardwired

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About IEDs - Intelligent Electronic Device

• A dedicated controller for power system equipment
• Monitoring, measurement, protection / control of associated electrical equipment
  – Protective relays
  – Transformer tap change controllers
  – Circuit breaker controllers
  – Capacitor bank switches
  – Re-closer controllers
  – Voltage regulators
  – Power meters
• Local Support for logic processing
  – Local fast execution of logic necessary for substation automation applications
    ◦ Interlocks
    ◦ Load shedding
    ◦ Load restoration
Traditional ECMS Implementation

- Third party software such as Wonderware, Cimplicity, ClearSCADA or RSView generally is used.
- Data is gathered from devices using a variety of legacy protocols.
- Simple devices may support common daisy chain communications such as Modbus RTU, Allen Bradley DF1, Profibus etc.
- Microprocessor based protection relays typically support Ethernet protocols such as Modbus TCP/IP or DNP 3.0.
- A separate database is configured for all information that is to be displayed on the substation HMI.
- Data to be shared with DCS has to be configured and sent over to the process control system over dedicated communication channels, typically via Modbus TCP/IP.
- Alarm systems are totally independent.
- Devices are polled for data on a continuous basis which can slow down communication speeds.
About IEC 61850

• IEC 61850 is a standard, not a communication protocol
  – Developed to support electrical substation automation
    ♦ A standard for the design of electrical substation automation

• The standard consists of two main protocols
  – MMS (manufacturing message specification)
    ♦ Supervisory control & data acquisition files transfer, messaging, reporting
  – GOOSE (generic object oriented substation event)
    ♦ Peer to peer between different vendor IEDs and the control system

• Defined objectives set for the standard
  – That the communication profile be based on existing communication standards
    ♦ Ethernet, PRP, HSR
  – High interoperability of IEDs (Intelligent Electrical Device) from different manufacturers
  – Be based on data objects that relate to the needs of the power industry
  – The protocols used will be open and support self descriptive devices
  – Engineering efficiencies
    ♦ Engineering, configuration, testing, commissioning
Benefits of IEC 61850

• Projects
  – Significantly reduces wiring, cable, design, engineering configuration, installation and commissioning
  – Provides a level of flexibility supporting changes with limited impact
    ♦ Changes are made in software versus physical changes to wiring
  – Designed for IED, switch gear interoperability
    ♦ IEC 61850 defines the manufacturer / supplier conformity to the standard

• Operations & Maintenance
  – An enabler that supports easy access rich data availability exchange with the control system & the end user
  – Improved control & management of electrical devices & power distribution
  – Decision making and control at the source within the IEDs - peer to peer capability
  – Improved reliability availability & asset awareness
  – Symptom based fault modeling – early event detection
  – Improved fault detection and diagnostic analysis capabilities
    ♦ Helping to driving a proactive versus reactive workflow
  – Increased manpower efficiencies & effectiveness
  – Data driven maintenance planning / scheduled maintenance
  – Site wide synchronized SOE
Who Is Powell Industries

• In business since 1947 - headquartered in Houston, Tx
  – Global presence
  – Powell manufacturing
  – Powell automation

• Core Products & Solutions
  – Largest North American manufacturer of ANSI metal clad switchgear
  – Pre-fabricated and fully integrated E&I substations
  – ANSI AR metal-clad/enclosed switchgear & MCC
  – IEC AR switchgear & MCC
  – ECM Applications & power management applications
  – Pioneer of the packaged substation concept

• Integrated Engineering and Manufacturing Facilities
  – Hardware
  – Software applications
Powell Integrated Engineering / Factory Testing

- FAT & SAT test plan development
- Complete integrated Factory Acceptance Testing at Powell (LV, MV, HV)
- Performed co-ordination & testing of other subsystems globally
- Complete single source site commissioning for the Switchgear and ECMS
The Powell / Honeywell Partnership

- Honeywell & Powell are both automation solution providers
  - With different complementary core competence skill sets
  - Vertical market expertise

- Honeywell & Powell have a business partnership focused on the delivery & execution of ICSS / ECMS automation projects

- Honeywell Powell integrated project team

- Common engineering standards
  - Libraries, project schedule, tools
  - Methodology (LEAP)

- Scope of supply
  - Electrical system design, engineering, testing, commissioning services

Partnering with Industry Experts for Success
Experion PKS – IEC 61850 Client / Host

• **Supervisory**
  – Support IEC 61850 MMS protocol
  – Capture & report alarms and events from IEDs
  – Support common time base between FTE and IEC 61850 network
  – Interface for IED events and SOEs
  – Maintain IED timestamps in the Experion event journal
  – Standard tools, displays, trending, groups, faceplates, reporting
  – Alarm management & analysis

• **Electrical system integration is not new to Experion**
  – Single line diagrams, SCADA interfaces - DNP3, IEC 61850, 60870

• **Control Capabilities**
  – A participant sitting on the IEC 61850 redundant network
  – Redundant path from Experion Controller to IEDs
  – Experion Controller data direct read / write with IEC 61850 IEDs
  – Integration with Experion Controller using standard Peer-Peer mechanisms
  – Control Builder for IEC61850 Interface Module Configuration
  – Fast C300 execution for electrical applications
  – Engineering - build template libraries of IEDs from offline IED ICD / CID files

• **IEC 61850 in not the only method of integrating with an ECMS**
ICSS / ECMS - Different Requirements / Functional Overlap

**ICSS**
- LV Motor control start/stop
- Process sequences
- Regulatory control
- Process Safety functions
- Process Control strategies

**Common**
- HMI
- Historian
- Alarm configuration / management
- Sequence of Events
- Cyber Security Compliance
- Engineering, Maintenance

**Asset Management**

**Easy Data Sharing / Exchange (Supervisory & Control Applications)**

**ECMS**
- Switchgear control
- Load shedding, balancing
- Generator management
- Electrical control logic
- IED engineering
Experion ICSS Architecture

- Experion Server
- Engineering Workstation
- Time Source
- Orion Operator / Maintenance Console

1. **FTE Switch**
2. **3rd Party UCP Controller**
3. **C300 Controller**
4. **Universal I/O**
   - Digital Input
   - Digital Output
   - Analog Input
   - Analog Output

- **Control Firewall**
- **FTE Control Network**
- **Electrical Bus Interface**
- **Safety Manager (ESD / F&G)**
- **Profibus / EIP, MB, UIO etc.**
- **Universal I/O**
  - Digital Input
  - Digital Output
  - Analog Input
  - Analog Output

- **LV MCC**
Experion ECMS Architecture

- Experion Server
- Engineering Workstation
- Time Source
- Orion Operator / Maintenance Console
- FTE Switch
- Control Firewall
- C300 Controller
- 3rd Party UCP Controller
- Universal I/O
  - Digital Input
  - Digital Output
  - Analog Input
  - Analog Output
- IEC61850 Interface
- MV, HV Electrical Equipment
  - IEDs
- IEC61850 PRP Network
  (HSR Option)
- IEC61850 Switch
- Optional industrial PC / Server in substation
ICSS / ECMS – One System

Scope of Responsibility - Based on Asset Model Definition
Summary – A Common Platform

• Common platform approach for process and electrical automation

• Monitoring and control of electrical equipment is just as important as for the process equipment it powers

• Honeywell delivers a unique electrical automation solution
  – Providing the power and electrical management information directly to the operator and maintenance personnel
  – Power control information directly to the process controllers

• Experion PKS Orion provides a common platform approach
  – Delivering the highest level of reliability, safety and security
  – At reduced cost of ownership
For more information …

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