EXPERION PKS CONTROLS
ELECTRICAL SYSTEMS TOO!
Abstract

• 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 an integrated electrical automation can be achieved using your Experion PKS system
Some Sparkling Images
Power

- The power system is the ‘lifeblood’ of the whole plant and therefore it must be predictable, provide high availability and reliability.
## Powering the Process

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**Supplying Power to Process Assets**

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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
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
Common Active & Reactive power analogies
Load Shedding

Figure 13: Frequency Based Load Shed Schematic
Generator coordination
Tap Changer Control
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 – Standalone Automation

ECMS / ICSS sharing a common infrastructure

Supervisory / HMI Server

PLC

Remote IO

Turbine Control Panel

ASDS Control Panel

HVAC Control Panel#1

HVAC Control Panel#2

Experion Server

ICSS Operator Station

Diesel Control Panel DSM

Turbine Unit Control Panel DEM

Remote IO

Relay

Relay

Relay

Hardwired

Hardwired

Ethernet

Analog / Digital

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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
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
About IEC 61850

• Defined objectives set for the standard
  - That the communication profile be based on existing communication standards
    ▪ Ethernet, PRP (ring protocol), HSR (ring protocol)
  - 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
Benefits of IEC 61850

- 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 per 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
ICSS / ECMS - Functional Overlap

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

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

**Common**
- HMI
- Historian
- Alarm configuration / management
- Supervisory
- Continuous monitoring & control
- Cyber Security Compliance
- Engineering, Maintenance
Ethernet Interface Module (EIM)

- A new Series C Hardware Platform
- Based on Common Platform
- Full redundancy
  - Module
  - Network
- Embedded Control Firewall functionality
- Support for Level 0 I/O Networks
- Extended temperature range: (-40°C to 70°C)
- Initial protocol support for:
  - Ethernet-IP
  - IEC-61850

- Support for multiple C300s per Ethernet Interface Module = 5
- Support for multiple Ethernet Interface Modules per C300 = 5

One Hardware Module - Multiple Personalities
Experion PKS – IEC 61850 Client / Host

- Electrical system integration is not new to Experion
  - Single line diagrams, SCADA interfaces - DNP3, IEC 61850, 60870
- 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
- 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 is not the only method of integrating with an ECMS
Detail EIM presentation by Peter Overgaauw
IEC61850 Electrical Management with EIM

- IEC 61850 for Power Management
  - IEC61850 MMS support carried forward
  - Full IED SOE support 10ms with Event Recovery
  - Supports PRP or HSR Network without REDBOX
  - Support EIM Redundancy

- Experion with direct access to IED data
  - Current & voltage measurements, status, interlocking information etc.
  - Transmitting / receiving of IEDs open and close commands
  - Intelligent Electronic Device (IED) representation
  - Experion system features - graphics, faceplates, alarms and event lists, including time-stamped, alarms / events (SOE) and historian

Experion PKS as Electrical Control & Management System (ECMS)
Experion ECMS Architecture

- Experion Server
- Engineering Workstation
- Time Source
- Orion Operator / Maintenance Console
- FTE Switch
- 3rd Party UCP Controller
- C300 Controller
- Universal I/O
  - Digital Input
  - Digital Output
  - Analog Input
  - Analog Output
- IEC61850 Interface (EIM)
- IED Tools
- Optional industrial PC / Server in substation
- IEC61850 Switch
- IEC61850 PRP Network (HSR Option)

- IED Tools
- MV, HV Electrical Equipment IEDs
- FTE Control Network
- Control Firewall
ICSS / ECMS – One System

Scope of Responsibility - Based on Asset Model Definition
Basic IEC-61850 Functionality in EIM

- IEC Function Blocks contained in EIM:
  - IEC 61850 Protocol Block
  - IED Blocks

- ICD and CID import for building above Block templates in Control Builder

- MMS Request/Response protocol used to fetch all block parameters when subscribed to from CDA (C300 Peer-Peer, Display, and/or History access)

- Support for IED MMS Reports (Buffered and Unbuffered) via a new Subscribe Block (MMSSUB)

- Certain Report Data types (BOOL, INTs, and Quality) can be configured to generate SOE events with the IED original timestamp being preserved.
  - Buffered Reports support SOE Event recovery from the IED on temporary communication loss, e.g. Redundant EIM failover.
IED block assigned to IEC61850 Protocol Block

- Drag and drop IED on to the IEC61850 Protocol Block
IED – Associate CID/ICD File

- Existing Association:
  - IED Name:
  - AP Name:
  - IP Address: 0.0.0.0
  - FileName:

- Select New Association:
  - Select File:
  - Available IEDs:

- Select | IED Name * | AP Name * | IP Address *

- Association succeeded.

- Available IEDs:
  - Select | IED Name * | AP Name * | IP Address *
  - Check | A.A21H001A2 | LDO | 102.10.18.101
  - Uncheck | Client1 | LDO | 102.10.18.101
IEC61850:IED Block, IED_241 - Parameters [Project]

Main

Tag Name: IED_241
Item Name:
Keyword Description:
Execution State: INACTIVE
Associated Asset:

Device Configuration

File Name: REF615.cid

Device Information

Device IP Address: 192.10.18.101
IED Connection Status: NotLoaded

CID Information

Header ID: ID
Version:
Revision:
CID Load Status: FILENOTLOADED
CID Load More Info: 0

IED Information

IED Name: AA2J1Q01A2
Manufacturer Name: ABB
Device Type: REF615
Configuration Version:

Logical Device Information

<table>
<thead>
<tr>
<th>Logical Device Inst</th>
<th>Hash Code</th>
<th>Assigned Instances</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>513345105</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>110836128</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3952422882</td>
<td></td>
</tr>
</tbody>
</table>

Show Parameter Names

OK  Cancel  Help
To create an MMSSUBS Block Instance, open the IED instance configuration form.

Navigate to the Subscriber block tab.

Check the Create parameter associated with the MMS Report Name to be created,

Click on OK.
Create - MMS Subscriber

The MMS Subscriber block is created and assigned to the IED block.
MMS Subscriber – Main Form

IEC61850:MMSSUBS Block, MMSSUBS_243 - Parameters [Project]

Main
- Tag Name: MMSSUBS_243
- Item Name #:
- Execution Order in CM: 10

Control Block Information
- Name: rcbStatDR
- Description:
- Data Set: StatDR
- Report ID: BAY1LD0/LLN0$BR$rcbStatDR
- Config Version: 1.0

IED: AA2J1Q01A2

Buffered Report Information
- Buffered Report: checked
- Buffer Time: 100

Trigger Options
- Options:
  - GI
  - INTEGRITY
  - DATA UPDATE
  - QUALITY CHANGE
  - DATA CHANGE
- Integrity Period: 3000

Optional Fields
- Fields:
  - Sequence No
  - Report Time Stamp
  - Reason For Inclusion
  - Data Set
  - Data Reference
  - Buffer Overflow
  - Entry ID
  - Configuration Revision
  - Segmentation

Show Parameter Names

OK  Cancel  Help
MMS Subscriber – Data Set Form

User will be able to modify the parameter name on the grid in the Data Set tab.

User can also select certain parameters (BOOL, INT, QUALITY) to generate SOE events on change.
New C300 DSIN Block and EIM DSMAP Block

- A new Data Set Input (DSIN) Block has been added to Control Builder Utilities to acquire MMS Report Data
- The DSIN Block will only run on the C300 V3 with Large Memory
  - Initially 50ms CEE support
  - 20ms CEE support will be added later together with GOOSE support
- For each DSIN Block, a new DSMAP Block is created in the EIM to acquire and send the MMS Report data to the C300.
To associate a MMS Subscriber block with the DSIN block, click on the point picker for the Source parameter.

The list of the Subscriber blocks will be shown. User will select the Subscriber block.
DSIN – Associated MMS Report Subscriber

The grid after the parameters have been populated.

The Number of parameters will be updated along with the parameter definition.
DSIN – Data Set Block Pins

The parameters in the grid can be exposed as output pins from the block pin form.

Click on OK to save the configuration.
The pins can be used to make wired connections.

The parameters defined in the grid can be used in named connections and expressions.
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
Overall Summary

- A fully integrated common platform architecture serving both process and electrical automation
- Providing seamless power and electrical management information directly to operations and maintenance personnel
  - Experion Orion provides a common user interface
- Control type P2P data exchange between process & electrical controllers
- Delivering the highest level of reliability, safety and security
- An integrated project delivery approach based on LEAP methodologies leveraging common standards
- Reduced cost of ownership: Support, standard Experion tools, training, technology, wiring, commissioning, interposing relay cabinets, marshalling, simulation & testing

*monitoring and control of electrical equipment is just as important as the process equipment it powers …*