HYDROELECTRIC POWER PLANTS AUTOMATION USING IEC 61850:

EXPERIENCES AND IMPROVEMENTS FOR THE USER
1. IEC 61850 principles
IEC 61850 – Principles and evolution

IEC 61850

Common information model

Standard communication mechanisms

Distributed Energy Resources

Hydro – Wind

Substations

IEC 61850 Devices

Protective relays

SCADA HMI

Logic Controllers

Remote Terminal Units

Meters

Inverters

IEC 61850 – Enhancing hydroelectric power plants, 9-11 April Grenoble
IEC 61850 – Motivation to use IEC 61850 in Hydro automation

User requirements

- Timestamps
- Event list on comms failures

Technology available

- INGESYS IC3 PLC
- INGESYS IT SCADA – HMI
- INGEPAC Protective relay
IEC 61850 architecture

MONITORING AND TELECONTROL

SCADA – HMI – (RTU)

Generator Protective relay
Transformer Protective relay
IC3 Group controller
IC3 Auxiliar services and general set-points

PROTECTION

CONTROL + REGULATION

IEC 61850 network
IEC 61850 engineering process

1. IEC 61850 Modeling
2. Protection integration
3. System configuration
4. SCADA configuration
5. Logic controller programming
6. Validation and testing
Step 1 – Logic controllers IEC 61850 modeling

IEC 61850 defines a virtual information model of the hydro power plant components using “Logical Nodes”.

* ICD: IED(Intelligent Device) Capability Description
Step 2 – Integration of protective relays

- Engineered according to utility requirements
- Provided by manufacturer
- Group controller ICD file
- Plant controller ICD file
- Generator Protection ICD file
- Transformer Protection ICD file
- Hydro power plant complete “virtual” information model SCD file

*SCD: System Configuration Description*
Step 3 – System configuration – Data interchanges

- Gen. Prot.
- Transf. Prot.
- Group Controller
- Group Controller 1
- Plant Controller
- Group Controller 2

SCADA HMI
Step 4 – SCADA Configuration

Each IEC 61850 logical node defines a set of standard data points for status information, commands or/and settings.

KPMP
Logical node for Pump information

SCADA manufacturers can define component libraries with predefined objects that use the standard IEC 61850 data information.
Step 5 – Programmable Logic Controller programming

- IEC 61850 Server
  - KVLV
  - SPRS
  - XCBR
  - KPMP
  - HSEQ

IEC 61850 model binding to 61131 information
2. Advantages for the user
Advantages of using IEC 61850

1. Standard naming and format
2. Integration of protective relays
3. Sequence of events
4. Time stamping of data
5. Wiring reduction
1. Standard naming and format

Each utility or system integrator defines the information name and format. Conversions are needed.

The standard defines the name and the format of each data point.

Time reduction.
2. Integration of protection devices

All protection function logical nodes start with “P”

FROM THE IEC 61850 INTERFACE ALL RELAYS LOOK EQUAL.

The Trip is always “Op”

Connect the trip information with the PLC and done
INTEGRATED !!!

Time reduction.

IED xxx
LDXXX
PIOC
PTOC
PXXX
3. Sequence of events

MODBUS Basic polling:
If communication link is broken, sequence of events is lost.

IEC 61850 includes a native “Buffered Reporting” mechanism.
The server stores events in case of communication lost. All IEC servers behave the same way.

BRCB: buffered report control block

Better functionality.
4. Time-stamping

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Digital inputs with 1ms resolution
IEC 61131 data change with TASK cycle resolution

More detailed sequence of events.
Events not related to scan cycle period

Digital inputs with 1ms resolution
‘Trips’ with 1ms resolution

Better functionality.
5. Wiring reduction – GOOSE – Generic Object Oriented System Event

Wire and communication failure detection.

Aggregation: an Ethernet cable transports several digital signals in 1 GOOSE message.

More security and cost reduction.
3. Conclusions
CONCLUSIONS

Our experience in engineering time

- Modbus
- Modbus MULTIVENDOR
- FIRST IEC 61850
- IEC 61850
- IEC 61850 MULTIVENDOR
**CONCLUSIONS**

IEC 61850 is a valid solution for hydro power plant automation.

- First 2 IEC 61850 projects required big effort.
- Better in functionality.
- More efficient in multivendor projects.
- We use it depending on the user requirement and the devices to integrate.
- More than 10 IEC 61850 hydro projects mainly in Spain.
Thank You