Study Committee B5

Protection & Automation

Paper B5-903

Digital substation for EDF : Engineering approach and E-Monitoring development

V. BOUVIGNIES – S. AUPETIT – R. BELTRANDO

EDF – France

Context

For several years, EDF has identified the need to **develop skills** and to exploit the new potential delivered by **the international standard IEC 61850** in the field of **Protection Automation and Control Systems** (PACS).

EDF Strengths for IEC 61850 digital substation development

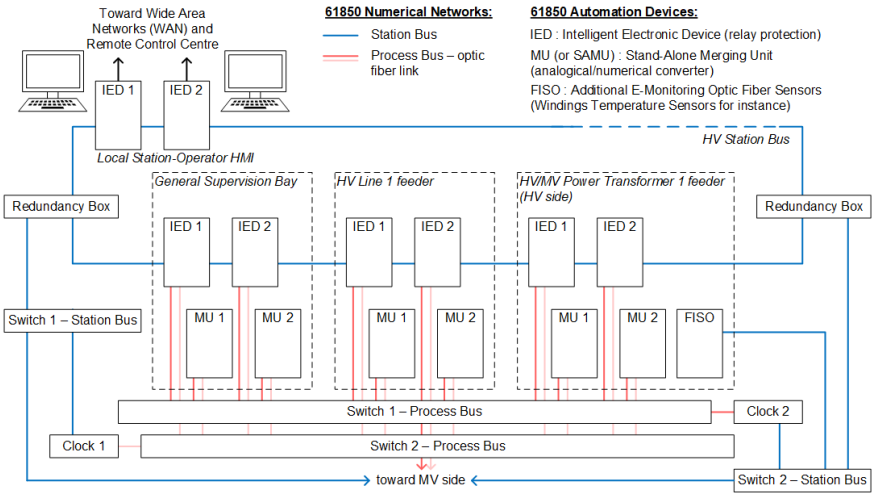
- A strong R&D department (participation in standardization organizations, in-house strategic tools development).
- An engineering unit (CIST-INGEUM) with a 20 years experience in the design of PACS solutions.
- A broad range of internal clients (hydraulic, nuclear power plants, TSO & DSO for French overseas territories) interested by numerical solutions.
- Strong, reliable and long-term relationships with external clients all over the world.

Opposite: Test panel in the Digital IEC 61850 Laboratory of R&D Department in Paris-Saclay

Advantages of IEC 61850 digital substations

- Increase of collected data: better HV materials knowledge, e-monitoring development, conditional maintenance, etc.
- Possibility to integrate LPIT/NCIT.
- Spatial flexibility for the IED.
- Numerical inter-operability and inter-changeability possibility.
- Less split-conductor cables in the substations.
- Control of the configuration process, and capacity to modify it without the IED constructor's help.

Below: Example of an IEC 61850 digital substation architecture, for the HV part.



Study Committee B5

Protection & Automation

Paper B5-903

Digital substation for EDF : Engineering approach and E-Monitoring development

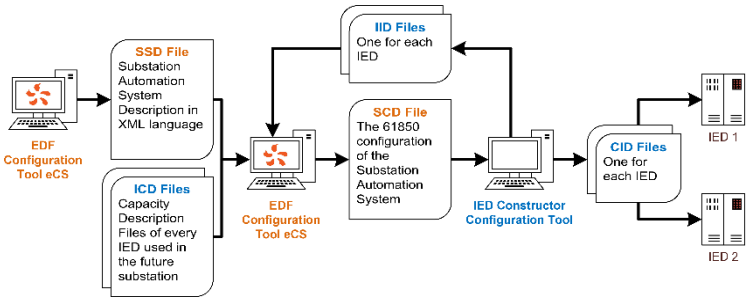
V. BOUVIGNIES – S. AUPETIT – R. BELTRANDO

EDF – France

IEC 61850 "home-made" solutions: 3 complementary approaches

Since 2017, three different French TSO/DSO asked EDF to help them to integrate IEC 61850 solutions into their PACS system. Because of these partners' different needs, EDF developed 3 approaches:

- An "All-inclusive" approach (2018-2021): unified HV/MV PACS for a new-built substation, currently in operation.
- An "Adjustable tailor-made" lead approach (started in 2019): unified HV/MV PACS for a long-standing partner aiming to look at the possibilities offered by IEC 61850 technology on an existing substation.
- A "New IEC 61850 EDF PACS common standard" approach (started in 2020): unified HV/MV PACS common standard thought globally and reproductible on various substation configurations (for around fifty substations).



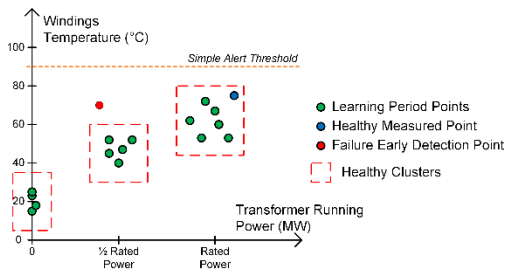
Above: EDF configuration process for IEC 61850 digital substations (orange: EDF, blue: constructor).

1st advantage: control of the configuration process

Development of a home-made system configuration tool (named eCS – evoluted Configurator System) which enables to easily create SSD files, to read IED Configuration Description file (ICD file) and then to create Substation Configuration Description file (SCD file).

Major benefit: EDF is able to make future changes itself on the PACS configuration: to add, to change or to remove one or several data or function will be done by EDF teams and no more by the industrial partners, saving costs and time.

Below: example of a failure early detection illustration.



2nd advantage: data collection and e-monitoring

One of the promises of IEC 61850 technology is the increase of data collection inside the substation.

Nowadays, grid operators or electric power plant owners are almost blind in regard to power transformers (a critical device): they know very little about transformers health status throughout their lifetime. The increase of data collection will bring about a radical change.

Short list of interesting data sets which could be collected in a substation:

- Windings temperatures (detect and prevent unexpected warming or cooling system failure).
- Dissolved gas concentrations in the transformer dielectric oil (prevent partial discharges).
- Oil level in the transformer converter (oil leaks).
- SF6 pressure (prevent airtightness problems).
- Closing or opening times of HV-circuit breakers or HV-disconnectors (mechanical problems).
- HV-lines temperatures (detect line elongation and prevent line defaults).
- Etc.