B5 – Protection & Automation

PS3 – Integration of Intelligence on Substations

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Challenges and Trends rising on Switchgear Monitoring and Control Applications

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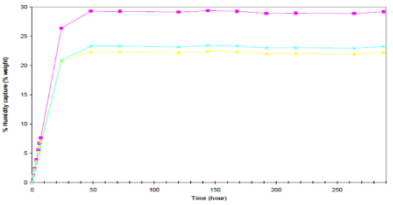
Motivation

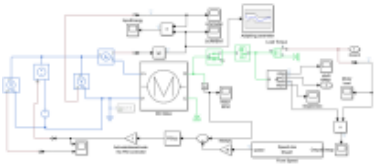
- Evolution of the requirements on maintenance: **switch from time-based to condition-based**
- Hardware evolutions that enable **more computational power locally**
- **Maturity of SF_6-free solutions**
- Interoperability challenge to integrate into **Asset Performance Management** solutions through **IEC61850**

Method/Approach

- Limitation of the impact of Switchgear Monitoring and Control **new technological solutions** on customers is key
- **Same digital sensor technology for SF_6-free and SF_6** monitoring can be used
- **Critical features selection**: no gas moisture monitoring when molecular sieves are installed



- **Digital Twin** can be integrated in already-existing digital solutions for disconnector switches customers



- **IEC61850** for interoperability, **Logical Nodes can be extended** to reflect technological breakthroughs.

Objects of investigation

1. Computing **density on C_4-FN mixtures** in monitoring IEDs

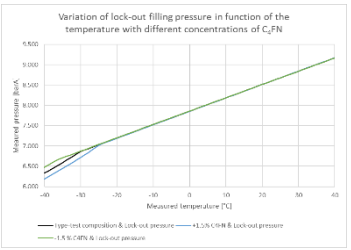
2. Impact of **molecular sieves** on moisture content in SF_6 and C_4-FN mixtures

3. Implementing **Digital Twin algorithms** in existing disconnector switches digital solutions

4. Interoperability of monitoring and control IEDs with **Asset Performance Management** solutions

Experimental setup & test results

-Mathematical model of density computation in C_4-FN mixtures, C_4-FN volume in which gas Pressure and Temperature are measured at different ambient temperatures



→ **Validation of the mathematical model and implementation in IEDs**

-Mathematical sensibility study on the impact of variating the C_4-FN mixture composition to assess the need for monitoring its ratio over time.

→ **No impact of the mixture ratio on the density of the gas for monitoring features**

-Commissioning simulation of SF_6 and C_4-FN gas volumes with surveillance of moisture content with and without molecular sieves installed.

→ **The efficiency of molecular sieves makes humidity monitoring in the gas compartments irrelevant**

Discussion & conclusion

- **Same hardware for all gas mixtures is possible**, and the existing communication infrastructures are already suitable for these new mixtures
- **Gas moisture monitoring irrelevant when using molecular sieves**, for both SF_6 and C_4-FN mixtures
- Applying multi-physical models such as **Digital Twins** in existing hardware enables **failures to be anticipated**
- **IEC 61850** with Asset Performance Management systems enable to **optimize asset performance** and O&M efficiency