CIGRE Study committe B5

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG B5.91

NAME OF THE CONVENOR
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TITLE
Monitoring and Diagnostic of PACS in Digital Substation

THE WG APPLIES TO DISTRIBUTION NETWORKS: YES

ENERGY TRANSITION
3 / Digitalization

POTENTIAL BENEFIT OF WG WORK
2 / potential interest from a wide range of stakeholders
3 / likely to contribute to new or revised industry standards
4 / state-of-the-art or innovative solutions or directions
5 / Guide or survey on techniques, or updates on past work or brochures

STRATEGIC DIRECTION
1 / The electrical power system of the future reinforcing the End-to-End nature of CIGRE: respond to speed of changes in the industry by preparing and disseminating state-ofthe-art technological advances
2 / Making the best use of the existing systems

SUSTAINABLE DEVELOPMENT GOAL
7 / Affordable and clean energy
9 / Industry, innovation and infrastructure

BACKGROUND :
The reliability and availability of Protection, Automation, and Control Systems (PACS) in digital substations depend on the effective monitoring and diagnosis of their components, including Intelligent Electronic Devices (IEDs), communication networks, and system connections. The transition to digital substations introduces several challenges:

- The integrated nature of IEC 61850-based PACS, governed by a single Substation Configuration Description (SCD) file, requires a new approach for maintenance and adds constraints in case of system upgrades and extensions.
- The operational status of protection IEDs and other IEDs can be directly monitored using dedicated monitoring Logical Nodes (LNs), which changes from conventional monitoring and failure detection methods.
- Abnormal GOOSE/SV messages can generate multiple simultaneous protection alarms, complicating root-cause identification.
- Physical network failures are often difficult to localise, reducing troubleshooting efficiency and increasing outage durations.

In addition, digital substations generate large volumes of diagnostic data. Effective processing and interpretation of these data are necessary to provide actionable insights. The growing complexity of PACS therefore necessitates advanced monitoring and diagnostic approaches to strengthen performance, improve reliability, and enhance fault response.

PURPOSE / OBJECTIVE / BENEFIT OF THIS WORK :

The objective of this Technical Brochure is to establish a comprehensive monitoring and diagnostic framework for PACS in digital substations by integrating advanced data analysis and automation, while leveraging the monitoring capabilities provided by the IEC 61850 standard.

The proposed work will include:

- Holistic monitoring of PACS, encompassing IEDs, communication networks, and system connections considering the monitoring capabilities provided by the IEC 61850 standard.
- Automated diagnostic analysis of system health through the processing of large volumes of operational data, employing both conventional methods and artificial intelligence (AI)-based techniques.
- Intelligent failure location and predictive maintenance to reduce downtime and enhance availability.

The expected benefits are:

- Improved reliability and availability of PACS through proactive failure detection and system-wide diagnostics.
- Increased efficiency in troubleshooting by utilizing automated analysis and predictive diagnostic tools.
- Optimization of substation maintenance strategies, reducing unnecessary interventions and minimizing operational risks.

This initiative will facilitate the transition from reactive monitoring to proactive, intelligent diagnostics, thereby improving resilience and operational efficiency in digital substations.

SCOPE :

This Technical Brochure will address monitoring and diagnostic methodologies for PACS in digital substations, with a focus on:

- Real-time monitoring solutions for PACS components, including:
  - IEDs, based on the monitoring LN defined in IEC 61850.
  - Communication links and communication networks within the PACS, based on:
    - available monitoring systems for switches, routers, etc;
    - specific IEC 61850 monitoring LN.
  - Identification of gaps and lacking functional specification for IEC 61850 monitoring LN, if any.
  - Configuration requirements and recommendations related to PACS equipment monitoring and supervision.
  - Recommendations for the performance of the PACS monitoring and supervision functions.
- System health assessment and diagnostic data analysis for detecting PACS component failures, employing:
  - Conventional approaches based on an analysis of published monitoring data.
  - AI-based approaches.
- Automated integration of protection operation reports to provide comprehensive insights into PACS component performance and failures.

Out of Scope:

The following areas are outside the scope of this work:

- Design or specification of Human-Machine Interfaces (HMI).
- Monitoring of primary power system equipment.
- Evaluation or validation of protection functions.

References:

- Paris Session 2020 – Paper B5-213: IEC 61850 communications monitoring and diagnostics system implementation experience
- Paris Session 2024 – Paper B5-10851: A practical approach to the requirements and strategies for monitoring the IEC 61850 process bus in a multivendor test platform
- Relevant IEC 61850 TR and IS.

DELIVERABLES AND EVENTS

Deliverables Types

Annual progress and activity report to Study Committee
Electra report
Technical Brochure and Executive Summary in Electra
Tutorial

Deliverables schedule

Technical Brochure	Q3	2029	Final version of Technical Brochure
Tutorial	Q3	2029	Tutorial

Time schedule

Q1	2026	Recruit members (National Committees)
Q2	2026	Develop final work plan
Q2	2029	Draft TB for Study Committee Review

APPROVAL BY TECHNICAL COUNCIL CHAIRMAN:
Rannveig S. J. Loken
January 06th, 2026