CIGRE Study committe B5

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG B5.90

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TITLE
Guidelines for commissioning and testing of fully digital PACS

THE WG APPLIES TO DISTRIBUTION NETWORKS: YES

ENERGY TRANSITION
3 / Digitalization

POTENTIAL BENEFIT OF WG WORK
1 / commercial, business, social, economic benefits
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

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

BACKGROUND :

The transition to fully digital Protection, Automation, and Control Systems (PACS) in substations has brought about a fundamental transformation in relay protection methodologies. Optical fibre transmission of GOOSE and Sampled Values (SV) messages is progressively replacing traditional hardwired circuits, resulting in systems that are increasingly integrated and interdependent.

This digitalisation introduces new challenges, including the impossibility to monitor the status of binary information downstream of the process interface IED without digital tools and the need for a different approach for failure diagnosis.

In accordance with IEC 61850, system configuration is centralised through the Substation Configuration Description (SCD) file. This yields consistent configuration but adds constraints in case of system upgrades or equipment replacements. Consequently, coordinated testing across multiple devices has become indispensable, increasing the risk of extending outage durations and maloperation when performed in the live substation.

Factory Acceptance Testing (FAT) validates protection and control logic under controlled conditions; however, it cannot replicate the full scope of integration with the process level. Site Acceptance Testing (SAT), while focusing on physical circuit verification and basic configuration checks, needs standardised and automated procedures. To address these issues, advanced verification and testing methodologies are required to improve efficiency, enhance system reliability, and reduce reliance on manual interventions.

PURPOSE / OBJECTIVE / BENEFIT OF THIS WORK :

This working group seeks to develop guidelines for testing methods to improve the commissioning of fully digital PACS, with particular emphasis on enhancing Site Acceptance Testing (SAT). The expected benefits include:

- Increasing commissioning efficiency by validating system integration in pre-installation environments.
- Reducing power outages during extensions and retrofits by minimizing on-site testing time.
- Enhancing safety through the shift from manual to automated verification processes.
- Improving overall efficiency by simulating realistic process interface conditions prior to deployment.

SCOPE :

The guideline developped by the WG proposes methodologies for commissioning and Site Acceptance Testing (SAT) of protection and control Intelligent Electronic Devices (IEDs) in digital substations. It also proposes an enhanced approach to Factory Acceptance Testing (FAT) to streamline and strengthen the commissioning process.

Key focus areas include:

- Simulating process interface and field environments for IEDs, external control circuits, and substation automation systems.
- Defining methodologies for comprehensive system testing based on IEC 61850 features, covering different scenarios such as:
  - FAT, where protection and control systems are not connected to the process interface
  - partial on-site-system testing, where PACS are interfaced with the live substation.
- Development of methods to establish automated verification procedures, defining applicable scenarios, and recommending best practices for testing digital PACS.

This guideline promotes an integrated, IEC 61850 based testing strategy in which FAT plays a pivotal role in reducing on-site workload, mitigating risks, and facilitating smoother commissioning.

The technical recommendations aim to preserve the resilience and availability ensured by conventional testing methods, while adapting and streamlining practices to align with the capabilities of fully digital PACS and leverage the potential of IEC 61850 features, without introducing additional functions intended only to maintain legacy approaches.

Out of Scope:

- Detailed criteria for specific protection function tests and schemes.
- Implementation aspects of IEC 61850-based digital PACS covered by WG B5.88 “Implementation Guide for Fully Digital IEC 61850-based Protection, Automation and Control Systems”.

References:

TB 401 - Functional Testing of IEC 61850 Based Systems

TB 637 - Acceptance, commissioning and field-testing techniques for protection and automation systems

TB 760 - Test strategy for Protection, Automation and Control (PAC) functions in a fully digital substation based on IEC 61850 applications

Paris Session 2024 - Session materials – Study Committee B5, PS 1 - Practical experiences and new developments of process and PS2 - Acceptance, commissioning, and field testing for protection, automation and control systems

DELIVERABLES AND EVENTS

Deliverables Types

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

Time schedule

Q1	2026	Recruit members (National Committees
Q2	2026	Develop final work plan
Q2	2029	Draft TB for Study Committee Review
Q3	2029	Final TB & other deliverables

APPROVAL BY TECHNICAL COUNCIL CHAIRMAN:

Rannveig S. J. Loken
January 06th, 2026