CIGRE Study Committee B5

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG[1] SC B5.86	**Name of Convenor:** Alex Apostolov (US)

Strategic Directions #[2]: 1, 2	**Sustainable Development Goal #[3]: 9,12**

This Working Group addresses these Energy Transition topics:

	Storage	**None of them**
	Hydrogen	
	Digitalization	
	Sustainability and Climate Change	
x	**Grids and Flexibility**	
	Solar PV and Wind	
	Consumers, Prosumers and Electrical Vehicles	
	Sector Integration	

Potential Benefit of WG work #[4] : 1, 2, 3, 4, 5

Title of the Group: Protection Automation and Control System interfaced asset management and condition monitoring using innovative technologies

Scope, deliverables and proposed time schedule of the WG:

Background:

In the context of fully digital substations, a variety of information sources generate continuous and discontinuous data flows. More specifically, most of the traffic is generated by physical and digital asset monitoring devices (e.g., data traffic probes and field sensors, specific monitoring devices, such as Dissolved Gas Analysers (DGA)), as well as PACS (Protection Automation and Control Systems) infrastructure equipment (IEDs – Intelligent Electronic Devices, switches, clocks, servers, virtualised environments). Process bus and Process Interface Units (PIU) allow digitisation of the interface with primary equipment, including binary status information, current and voltage measurements, control commands and sensors to measure temperature, pressure of insulating gases and mechanical forces. The use of PACS interfaced PIU potentially allows significant synergies using common sensors, acquisition infrastructure and communication resources.

If not well addressed, the data produced by all these sensors and monitoring systems increase the overall system complexity in the substation and produce large amounts of heterogeneous and unstructured data. This may also have adverse consequences for cybersecurity, communication network and PACS efficiency. Also, increased human resources, to monitor and analyse the data may be required.

To prevent the aforementioned risks, references and guidelines are asked for by the industry, covering common data acquisition, data formats and communication infrastructures, as well as efficient and secure data management pipelines. In this regard, the use and definition of a shared common data format between PACS and the remote applications that use this data is a fundamental interoperability enabler. This could be based on IEC 61850 or CIM (Common Information Model) but requires in any case the definition of interoperable data profiles.

Moreover, digital PACS can host functions providing local data storage and on-site pre-processing capabilities. This allows to homogenise calculations and to reduce the volume of

data to be sent to the remote subscribing applications. The PACS can also host advanced functions based on Machine Learning approaches (ML) or Artificial Intelligence (AI) to support more general centralised applications.

Purpose/Objective/Benefit of this work:

The aim of the Technical Brochure (TB) developed by the working group is to give an overview of the main data sources that interface with Protection Automation and Control System and including recommendations and introduce condition monitoring using innovative technologies.

Scope:

The Technical Brochure produced by the working group is expected to cover the following items.

- Overview of main data sources interfaced with PACS
  - characterisation of the conveyed information (e.g., data types and volumes, security concerns, priority levels, subscribing applications and services)
- Recommendations for Interoperable data formats
  - standards for the management of asset data (growing requirement for the industry)
  - integration of data in one platform and workstream.
- Use cases
  - use cases in physical asset management (condition monitoring) applications and collected field information from primary equipment (such as oil temperature, vibrations, mechanical forces, partial discharge, operating time)
  - use cases in digital asset management applications (e.g., asset inventory probes, cyber intrusion detection devices and cyber threat detection systems)
  - use cases in PACS asset management (IEDs, switches, clocks, servers, virtualised infrastructure) and collected device information (such as temperature, CPU load, auxiliary supply board, reboots, memory, status information etc.)
  - use cases in weather based local applications and general environmental information such as wind speed, air temperature, humidity, solar radiation, intrusion detection
  - use cases in substation perimeter awareness systems such as gate access control, fire protection, physical intrusion detection devices, digital security fence.
- Feasibility analysis and challenges in the implementation of the different use cases
  - required computing and storage resources
  - functional and performance requirements
  - Possibility of preprocessing functions and advanced data analytics “on the edge” (i.e., implemented in PACS)
  - Use cases
  - Advantages and drawbacks
  - Guidelines and recommendations
- Machine Learning /AI Applications in Assessing Condition with risk of Outages implemented in PACS
  - Offline / online applications
  - Weather Impacts on Asset Failures and Fault Occurrences
  - Use Cases of Different ML and AI Approaches to Assessment of Risk of Asset Failures and Fault Occurrence due to Weather Conditions
  - Use of ML/AI Models in Risk Assessment Primary equipment state, Asset and Outage Management
  - Implementation Requirements

- Risk Mitigation Strategies and Expected Benefits
- Description of Training Needs

A survey among utilities about the practice of implementing data treatment methods shall be conducted by the Working Group, giving the state of the art of the approaches implemented in the industry.

Out of scope:

- Applications in data centres, maintenance centres and network control centres.
- Methodology and applications of condition monitoring data for the different primary equipment.
- Communication structure between PACS and remote data centre

Remarks:

- Liaise with D2.53

References

[1] CIGRE Cairns Symposium – Session B5 papers 1147, 1185 & 1398

Deliverables:

☒ Annual Progress and Activity Report to Study Committee
☒ Technical Brochure and Executive Summary in Electra
☒ Electra Report
☐ Future Connections
☐ CIGRE Science & Engineering (CSE) Journal
☒ Tutorial
☒ Webinar

Time Schedule:

• Recruit members (National Committees, WiE, NGN)	Qtr 3 2024
• Develop final work plan	Qtr 4 2024
• Draft TB for Study Committee Review	Qtr 4 2028
• Final TB	Qtr 1 2029
• Tutorial	Qtr 2 2029
• Webinar	Qtr 3 2029

Approval by Technical Council Chair:

Date: August 13th, 2024

Notes:
[1] Working Group (WG) or Joint WG (JWG),
[2] See attached Table 1,
[3]See attached Table 2 and CIGRE reference Paper: Sustainability – at the heart of CIGRE's work.
[4] See attached Table 3

WG Membership: refer Comments at end of document

Table 1: Strategic directions of the Technical Council

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-of-the-art technological advances
2	Making the best use of the existing systems
3	Focus on the environment and sustainability (in case the WG shows a direct contribution to at least one SDG)
4	Preparation of material readable for non-technical audience

Table 2: Environmental requirements and sustainable development goals

	CIGRE selected the 7 SDGs that are the most relevant to CIGRE. In case the WG work refers to other SDGs or do not address any specific SDG, it will be quoted 0.
0	Other SDGs or not applied
7	**SDG 7: Affordable and clean energy** Increase share of renewable energy; e.g. expand infrastructure for supplying sustainable energy services; ensure universal access to affordable, reliable, and modern energy services; energy efficiency; facilitate access to clean energy research and technology
9	**SDG 9: Industry, innovation and infrastructure** Facilitate sustainable infrastructure development; facilitate technological and technical support
11	**SDG 11: Sustainable cities and communities** Increase attention on sustainable and resilient buildings utilizing local (raw) materials, power for electric vehicles, strengthening long-line transmission and distribution systems to import necessary power to cities, developing micro-grids to reinforce the sustainable nature of cities; protect and safeguard the world's cultural and natural heritage; reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and waste management
12	**SDG 12: Responsible consumption and production** E.g. Promote public procurement practices that are sustainable; address reducing use of SF6 and promote alternatives, encourage companies to adopt sustainable practices and to integrate sustainability information into their reporting cycle, address inefficient fossil-fuel subsidies that encourage wasteful consumption
13	**SDG 13: Climate action** E.g. Increase share of renewable or other CO_2-free energy; energy efficiency; expand infrastructure for supplying sustainable energy; strengthen resilience and adaptive capacity to climate-related hazards and natural disasters; integrate climate change measures into national policies, strategies and planning; improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
14	**SDG 14: Life below water** E.g. Effects of offshore windfarms; effects of submarine cables on sea-life
15	**SDG 15: Life on land** E.g. Attention for vegetation management; bird collisions; integration of substations and lines into the landscape

Table 3: Potential benefit of work

1	Commercial, business, social and economic benefits for industry or the community can be identified as a direct result of this work
2	Existing or future high interest in the work from a wide range of stakeholders
3	Work is likely to contribute to new or revised industry standards or with other long term interest for the Electric Power Industry
4	State-of-the-art or innovative solutions or new technical directions
5	Guide or survey related to existing techniques; or an update on past work or previous Technical Brochures
6	Work likely to contribute to improved safety.

Comments:

1) CIGRE Official Study Committee Rules: WG Membership

https://www.cigre.org/GB/about/official-documents

a. Only one member per country: by exception of SC Chair, WiE and NGN nominees.

b. WG nominees by NCs must first be supported by their National Committee (or local SC Member) as an appropriate representative of their country.

c. Acceptance of the nomination is granted by the SC Chair and advised to the WG Convener.

2) Collaboration Space

https://www.cigre.org/article/GB/collaborative-tools-2

CIGRE will provision the WG with a dedicated Knowledge Management System Space.

The WG will use the KMS for drafting collaboration, capture and retention of discussion and meeting records.

Official country WG Members will be sent registration instructions by the Convener.

Official country WG Members may request the WG Convener to allow additional access for an extra national subject matter specialist to aid in the work at the national level, including NGN members.