Standardised Protection & Control Schemes

This Technical Insight from CIGRÉ UK is based on the 2014 publication of CIGRÉ Technical Brochure (TB) 584.

Background

The electricity industry is operating under a challenging climate driven by some common factors. These include electricity market deregulation, a high volume of capital schemes due to network expansion and ageing asset replacement, as well as large scale introduction of new technologies. It is therefore important to find effective and efficient ways to manage limited resources and budgets whilst maintaining a high quality of network operations and asset management.

The rapid development of PAC (Protection, Automation and Control) technology has significantly improved efficiency, security and flexibility of the secondary systems within power networks; however it often leads to a shorter life span and increased complexity of the PAC devices. This may also cause additional complications in the design, build and management of PAC assets. Moreover, the shorter lifespan of the modern devices will further increase the volume of capital schemes for the utilities.

Standardised PAC schemes may help to overcome these challenges with the potential benefit of time, cost and resource savings, as well as risk reductions. CIGRÉ working group B5.27 was established to systematically investigate the benefits and implications of standardised PAC schemes, with the findings published in TB 584.

Benefits of Standardised PAC Schemes

The main drivers for development of standardised PAC schemes are quality, time and cost improvements in delivering, maintaining and operating secondary systems. The brochure examines the creation of such standard PAC schemes with the whole lifecycle considered. The technical quality and reliability of standardised schemes are likely to be higher than bespoke schemes, and the repeated use of a fully tested and proven design will help to reduce whole-life cost and project delivery risks of secondary systems.

Barriers and Risks of Standardised PAC Schemes

The brochure identifies a range of potential barriers associated with the development and implementation of standardised PAC schemes. Standardisation may yield a high number of standardised solutions due to a wide range and layout of primary systems in the existing substations if the standardisation process is not managed properly.

Large scale application of standard PAC schemes also carries the risk of common failures which may lead to partial or total collapse of a power network if the schemes contain generic functional defects or type faults. Therefore, it is crucial that standard schemes are properly specified, designed and thoroughly tested.

In addition, users and/or manufacturers will have to make significant initial investment in cost and resource to develop the standard schemes. The standardised designs may have to be used for a considerable period of time before the anticipated benefits can be fully realised.

Although the standard schemes could provide many financial and operational benefits, the flexibility of these schemes (i.e. ability to add/remove equipment and modify functions in the future) may have to be compromised for some real applications.

Development of Standardised PAC Schemes

Based on whole lifecycle requirements of secondary systems and practical experience from both manufacturers and utilities, the brochure has identified four key stages in a generic standardisation process, as detailed below:

Phase A - Creation of a standard PAC scheme functionality based on practical requirements and common practice (IEC, IET, CIGRÉ and IEEE Specifications/recommendations).

Phase B - Definition of standard substation bay layouts with fixed hardware interfaces based on practice within a utility.

Phase C - Definition of standard PAC devices such as intelligent electronic devices (IEDs) with standard wiring diagrams, setting policy, testing and maintenance procedures etc.

Phase D - Definition of operational and site specific parameters such as IED specific files and protection settings and validation procedures for specific applications.

Relevance to the UK

Since privatisation in 1989, the challenges faced by the UK power industry have also occurred in a wider global context. To improve efficiency and manage resource/ skill shortages in delivering a large number of capital schemes, some utilities such as National Grid have started to develop standardised protection and control bay solutions since the late 1990s, and the standardised schemes have been gradually implemented in the last decade or so. Leading manufacturers and solution providers have developed their standard solutions and implemented them in the UK and elsewhere worldwide.

The publication of TB 584 will have significant relevance to the development and application of protection and control technology in the UK power industry. For the utilities or suppliers who are intended to introduce standard PAC schemes, the document not only provides practical insights in terms of the benefits and potential issues of such schemes, but also gives a systematic development process based on lessons learned previously and international best practice. For those who have already implemented with standardised schemes, TB 584 can be used as a reference to improve both existing solutions and application practice.

With the introduction of the new regulation model – RIIO (Revenue = Incentives + Innovation + Outputs), power companies in the UK are incentivised to seek innovative approaches to further reduce capital and operational costs and improve efficiency. The standard PAC schemes may well be one of the solutions for the UK utilities to “outperform” the RIIO deal.

IEC61850 is becoming one of the most popular communication protocols used in substation protection and control systems due to its capability to enable vender interoperability and interchangeability. There are many on-going development activities in this area in the UK. The standardisation of PAC functions will play a key role in the development of IEC61850 based architecture for the substation secondary systems.

Despite many long term benefits and advantages, the development and implementation of standard PAC schemes will undoubtedly incur significant initial investment costs, which can be a challenge for a utility and/or a supplier, particularly smaller ones. To best utilise the effort and resources, sharing or jointly developing such schemes in a collaborative manner through national or international forums may be an efficient and effective way forward. In the UK, the Energy Networks Association (ENA) may be a potential platform for such collaboration.

In addition, to mitigate the risks associated with potential common failures of a standard PAC scheme, experience from the UK shows that apart from technical efforts in the design, testing and lifecycle management of such schemes, the issue needs to be carefully considered in the procurement strategy to minimise the impact on a power network.

Other Relevant CIGRE Technical Brochures

- TB 540: Applications of IEC 61850 Standard to Protection Schemes
- TB 421: The Impact of Renewable Energy Sources and Distributed Generation on Substation Protection and Automation
- TB 326: The Introduction of IEC 61850 and Its Impact on Protection and Automation within Substations
- TB 187 System Protection Schemes in Power Networks
- TB 011 Evaluation of Characteristics and
- Performance of Power System Protection Relays and Protective Systems

Find out more...

Founded in 1921, CIGRÉ, the Council on Large Electric Systems, is an international non-profit association for promoting collaboration with experts from all around the world by sharing knowledge and joining forces to improve the electric power systems of today and tomorrow.

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