

Busbar Protection Considerations When Using IEC 61850 Process Bus



Busbar protection systems protect substation busbars and associated equipment from the consequences of short-circuits and earth faults. In the early days of power system development no separate protection device was used for busbar protection. Remote end-line protections served as the main protection for busbar faults. As a result of increased network short-circuit capacity, dedicated differential relays for busbar protections have been applied to limit the damage caused by high fault currents.

Migration toward all-digital substation Protection, Automation and Control systems requires that all Protection, Automation and Control functions will be implemented based on measurements acquired locally at the power apparatus and shared over a communications network, with commands actuated over the network as well. This includes protection of the substation busbar itself.

Tripping for a busbar fault disconnects many network elements and considerably disrupts power flows in the system. Security, speed, and selectivity of busbar protection are therefore extremely important. The busbar protection scheme is often used to perform breaker failure protection, or at a minimum to execute the breaker failure trip command by identifying the correct breakers to trip. This function makes the busbar protection scheme even more critical.

Distributed busbar protection schemes with bay units used to measure currents, acquire breaker and disconnect switch status signals, and actuate the breakers, and with a central unit used to process the data and perform the differential protection, have been known for about three decades. These schemes use proprietary technology and they do not allow the bay units to be shared as a part of protection schemes for the network elements connected to the protected busbar.

The introduction of the IEC 61850 standard enables replacing these legacy schemes by process-bus based open-standard schemes where interoperable Merging Units (MUs) provide the current, voltage, and breaker and disconnect switch status measurements, and actuate the circuit breakers.

In this new interoperable architecture, Merging Units may be of different makes and models and are shared between the network element protective relays and the busbar protection scheme. Merging Units may be implemented as so-called Stand-Alone Merging Units (SAMU - IEC 61869-13) connected to conventional instrument transformers or associated with Low Power Instrument Transformers (LPIT - IEC 61869-7, -8). IEC 61869-9 (replacing UCA 9-2LE guidelines) defines the IEC 61850-9-2 profile of the sampled values streams published. IEC TC95 is presently drafting requirements for digitally interfaced protection functions.

These new schemes require careful considerations in relation to several technical issues, migration strategies, testing and commissioning, maintenance and lifecycle management.

The new Working Group B5.74, "Busbar Protection Considerations When Using IEC 61850 Process Bus", will primarily focus on the Merging Unit dynamic response requirements for secure and dependable busbar protection including measuring chain interoperability. The work also includes busbar protection settings recommendations to account for differences in the Merging Units dynamic response. The preferred architectures for process-bus protection schemes that share Merging Units with network element protection schemes related to networking, time synchronization, etc. will also be investigated.

Busbar protection redundancy considerations will be investigated including separation and independence of the primary and backup schemes while also allowing cross-usage of data from redundant Merging Units. The Working Group will give migration recommendations for hardwired centralized busbar protection schemes and legacy distributed protection schemes. Breaker failure protection is often part of the busbar protection and considerations in process-bus based busbar protection schemes will be evaluated.

The Working Group will evaluate considerations related to time overcurrent backup application in process-bus based busbar protection schemes including placement in the central unit or in the Merging Units that integrate protection functions. Focus will also be given to the busbar protection functionality, security and dependability enhancements possibly due to additional measurements like current transformer failure detection, enhanced security for hardware and other failures by using data cross-checking.

The Working Group will investigate the best practices for busbar protection configuration using IEC 61850 logical node and substation configuration data structures. This will include opportunities for auto-configuration and software-assisted configuration. Aspect related to testing, commissioning and maintenance issues when sharing Merging Units between busbar protection scheme and other network element protection schemes will be evaluated.

Finally, the advantages and disadvantages of integration process-bus based busbar protection schemes and network element protection including centralized protection schemes will be discussed.



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