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Question 3.04 What are other experiences to improve the specification, engineering, testing and maintenance to address the challenges in our industry?

IEC 61850´s definition of SCL language and a common data model, has opened the door for third party engineering tools and consequently to a top-down engineering process, where compatibility between Client and Server devices are harmonised. Utilising a standardised approach for IEC 61850 designs can drastically reduce the engineering time involved in preparing device configurations. The common origin of data in a top-down engineering process also leaves less room for errors and decreases the testing requirements for the PAC systems for both new installations and the upgrading of legacy systems.

The foundation for improvements in the engineering process starts from standardisation of initial phases. A key component is ensuring a standard IEC 61850 SAS architecture is developed. This architecture shall cover the Network topology with logical segmentation & communication redundancy, data flow, IP class management, time synchronisation, cyber security requirements (reference should be made of IEC 62443). The predilection for prioritising substation types and assigning different SAS architectures should be carefully considered against a one size fits all approach. The latter, significantly reduces the variation in standardised devices and configurations and consequently offers reduced asset management and supplier qualification effort, whilst offering greater economies of scale in the purchasing process.

Following the architecture, device specifications can be produced for all equipment such as IED, Gateway, Substation HMI, Ethernet Switch, GPS receiver and Firewall/Routers. The IED specification should include information such as functionality, I/O capacity, communication protocol and general attributes common to the IEDs. The interfaces and functionality required will not be the same for each IED type and it is likely that additional specification will be necessary for IED types such as Line Differential Protection, Bay Control Unit, Busbar Central and Distributed Units, Transformer Differential Protection etc. Whilst an advantage of standardising IED’s is that it allows for the early identification for training requirements for all O&M teams that will be using the equipment and reduced hardware variation for spare equipment, the main advantage is in the reduced variation of ICD templates.

IEC 61850 makes room for pre-configured ICD templates which not only describe device capability but rather contain all the possible pre-engineered information for a specific bay type and device type. During the creation of the templates this allows for the standardised engineering of the datasets, GOOSE, buffered and unbuffered report control blocks as well as the expected control signals should they be processed by the device. The required VLANs for the GOOSE and SV traffic can also be defined at this stage thus allowing for the standardisation of network topology. When ICD templates are produced, all of the transmission of signals are complete, therefore when final engineering of the IED is completed, all that needs to be associated are signals between to the client / server for example interlocking signals via GOOSE or RCB association to HMI/RTU/Gateway. This decreases the configuration time of the IEDs drastically. In the future, these ICD template files can be specified by SSD files but the current experience with textual descriptions is satisfactory.

It is not just the ICD template which should be specified. Signals to telecontrol should be similarly defined per bay type. Note that this means bay type is not just voltage level and topological position type but also switchgear type. Strict standardisation of switchgear per bay type means that the same telecontrol signals must be sent for each bay type. Where a Substation HMI is used, then graphical bay templates can be specified for each bay type along with Alarm and Event Behaviour.

The standard approach to the specification of ICD templates leaves less tasks for the SCT tool therefore allowing the SCT tool to become more automated for the communication configuration and other functions. This allows for the quick SCD file creation with all the templated information which then in turn is used by the IED configuration tool to produce the IED's CID files. This decreases the amount of time required to produce the specific relay configurations as a large percentage of the relay configuration is already completed thanks to the ICD template and the SCT tool.

The above statements are applicable to the top-down engineering approach. Bottom-up engineering benefits in certain scenarios an example being where an established in-service substations system requires a single selective asset replacement. Bottom-up engineering would be more effective and efficient to configure the individual device where top-down engineering is not implemented. Bottom-up configuration the IED is engineered directly with all datasets, reports, GOOSE that are configured to integrate with the existing system. Though the top-down engineering has greater initial cost and design complexity, the advantage is that the configuration can be reusable which reduces the whole life cycle costs. In the future this same SCD can be used for replacement as this can be directly imported into the new device with minor modifications allowing replacement to be more efficient in terms of cost & design.

In Conclusion:

- Utilising standard IEC 61850 design methodology reduces the engineering effort and testing time
- Efforts must be taken to reduce the number of configuration variants to allow for successful development of standard bays.
- Standardisation should be systemic from switchgear to architecture to device type to allow the successful implementation of the standard bay configuration and design.