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IEC 61850 Standard for an Efficient Energy Automation: A Key Concept for Smart Microgrid

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Abstract - *The IEC 61850 standards collaborated with industries and developers to create a unique setup in the power network for the protection of substation. This paper describes switchgear interlocking with IEC 61850 GOOSE. IEC 61850 standards is originally developed for substation automation and it has an excellent worldwide record as a standard communication protocol for coordinating the IEDs.*

Keywords – IEC 61850, IEDs, Switchgear, Substation automation, GOOSE, Protection, etc.

I Introduction

IEC 61850 GOOSE message communication between IEDS and bay control unit can be used for interlocking the switchgear at bay level. GOOSE stands for "Generic Object Oriented Substation Event" ant it helps to setup the fastest response in the network between the bay control (Server) and centralized station control (Client) [1]. The configuration tool provides the virtual view of the protection device (IEDs) and supports for remote configuration, and it helps to interlocking of a substation independent from substation [1,2]. As an example a double bus bar with two feeders system is shown in figure1. For substation interlocking the important information has exchanged between coupler and two feeders bus bar system.

The following information must be exchanged between server and client for interlocking the substation,

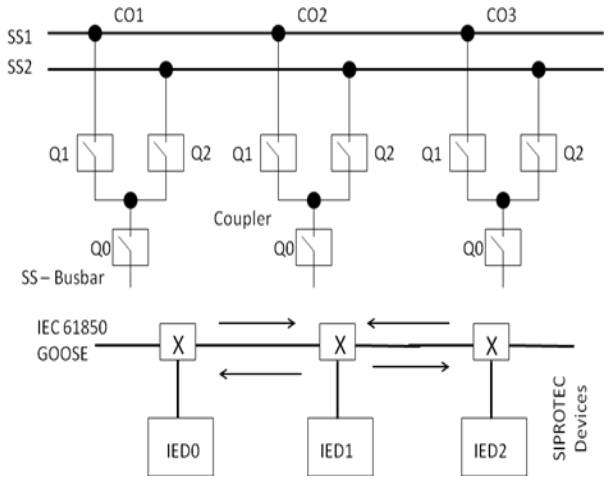

Figure1 Double Busbar System with 2 feeders

- Information from coupler to feeder: Stating that the coupler is closed. If this condition is existing, always the feeder may operate over the feeder bays (even if the feeder circuit breaker has closed).

- Information from feeder to coupler: Normally, the busbars connected through disconnections and two bulbar connecters at least closed with a bay, the coupler CO2 is permissible to operate the disconnections in the feeder when it no longer be opened, this operation is called as coupler switch blocking and the coupler bay will get this information from each feeder [2].

II Substation Interlocking

The SIPROTEC protective devices can be parameterized using DIGSI versatile engineering tool, IEC 61850 system configurations is used to integrate all the devices. Capabilities of DIGSI tool are revealed when the integrated SIPROTEC devices are Connected to it, then the operator can work with all the devices as one project in a substation [1, 3].

The substation configuration can be performed through following four steps,

- Creation of GOOSE information matrix in DIGIS.
- Preparation of the 'cfc' charts to generate the new messages and adding to 'cfc' chars for interlocking switchgears.
- Defining GOOSE subscriber, IP address assignment for setup the IEC 61850 communication in substation.
- Routing of subscribers GOOSE information.

In the above said example (fig.1),

The following information is required in three bay levels,

CO1: Transmitted Information (In CO1 bay, both the bulbar disconnections are closed) Received Information (coupler closed)

CO2: Transmitted Information (coupler closed) Received Information (In bay CO1 & CO3, bulbar disconnections are closed)

CO3: Transmitted Information (In bay CO3, bulbar disconnections are closed)
Received Information (coupler closed)

With above said the GOOSE informative matrix for the 20kv coupler unit CO2 is created in GIGIS and shown in figure2.

Parameters	Information		Source				Destination											
	Display	Type	BI	F	S	C	BO	LE	Buffer				S	X	C	D		CM
									O	S	T	W				C	D	
GOOSE	CO1SSDClo	ExSP			X				IO						X			
	CO3SSDClo	ExSP			X				IO						X			
	CO2CouplCI	SP				X			IO				X					

Figure2 CO2 Information Matrix in DIGIS

Each item in the GOOSE information has 'cfc' as source and the 'system Interface' as destination. The cross in the destination column tell the DIGIS to assign the logical node in IEC 61850 destination and user friendly abbreviation may entered here (e.g. 'CouplCl' for coupler closed, 'SI' for switchgear interlocking) as shown in figure3. The 'cfc' chart is created with an information of "CouplCl" and "Busbar disconnections in bay CO1/CO3 closed" and the 'cfc' chart may added for interlocking of switchgear(step2) [1].

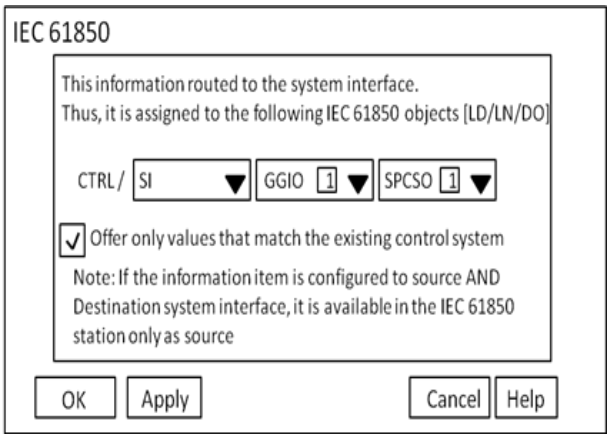

Figure3 Newly Created IEC 61850 Information Items

Third step is creating IEC 61850 substation and it can be created in the DIGSI manager in the same way of creating a device, and then a new icon will appear with the text 'IEC 61850'. This icon is the system configuration to manage the IP addresses of the users and provide the access to configure the GOOSE communication [1, 3].

III Monitoring Concepts

The connection monitoring is very essential, because the GOOSE communication sending the safety related data for interlocking of protection devices [1]. It must be reliable to detect and report the line failure and work selectively. So that the monitoring is takes place at two point of the system.

- Firstly, each Ethernet channel is monitored to check whether the connection with the switches are existing or not, it can be indicate the failure of one channel in the redundant communication, while the communication takes place through a second one.

- Secondly, the received information will be evaluated. If there is any interruption with an needed channel, the 'NV' (Not Valid) flag is enabled. The example in the figure4 illustrate that, the connection has interrupted between IED0 & IED1 [1,4].

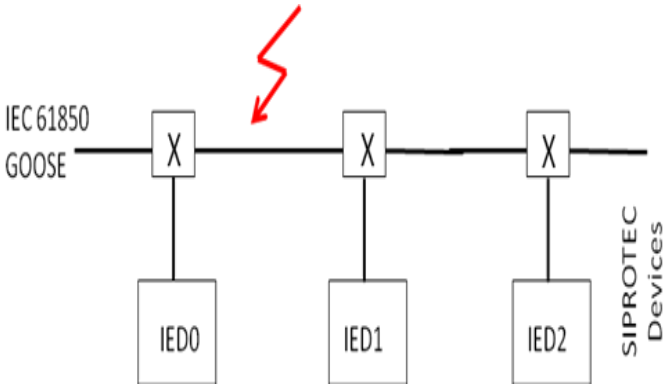

Figure4 Line Failure between Two Devices

In above said case, the coupler closed in IED1 and bay CO1 bulbar disconnections closed in coupler CO2 are considered as invalid information and the line interrupted connections are displayed with IED1 and IED2[1,2]. In this faulty case, the interlocking condition has remained blocked by processing the non-available information due to including the status with the conditions.

IV Conclusion

As a distributed application IEC 61850 GOOSE enables the implementation of switchgear interlocking substation wide. This will increase the availability and adding benefits by being independent from a centralized station controller. The said example clearly shows that, how a line connection between bay units is replaced easily and reliably by GOOSE messages and the interoperable solutions also possible by the standardization of IEC 61850 interface. In GOOSE

communication network, the information can be exchanged between different vendor equipment's.

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