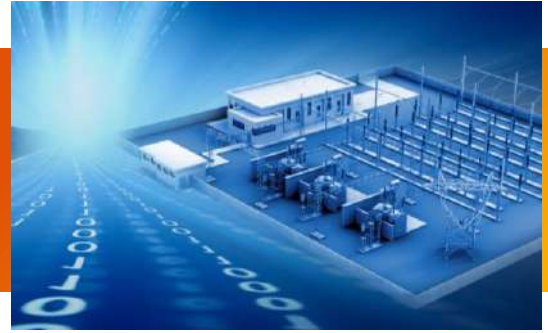


Software Solutions Suite for Standard IEC 61850 Power Utility Automation



CIRCE has developed four software solutions that enable easy interaction with IEC 61850 networks and systems. With GOOSE Conductor, IED Tester, GOOSE Panorama and GOOSE Miner, working with the GOOSE protocol is a flexible process, which includes creating and sending messages, interpreted data viewing, monitoring the communication status and displaying all grid information at once, instantly and in a user friendly way.

As the need for a new single international standard became clear and considering past experience in Europe and North America, the IEC 61850 standard was conceived to provide a framework covering all work carried out in Europe (IEC) and North America (EPRI). Based on the original approach to substation automation, the main objective was to enable **interoperability** among manufacturers by standardising communication and configuration method protocols. IEC 61850 defines LAN communication between protection, control and metering devices within a substation. The standard covers everything needed to design, operate and maintain control and protection systems. It also includes aspects such as data models and configuration, approval requirements and test mechanisms.

“IEC 61850 is now considered the worldwide market communication standard for substation automation”.

“The sector's top manufacturers are already applying IEC 61850 communication and configuration protocols to their systems.”

Functionalities

FUNCTIONALITIES Software Solutions– IEC 61850

	GOOSE Conductor	GOOSE Miner	GOOSE Panorama	IED Tester
Compatibility with any manufacturer and equipment	•	•	•	•
Advanced monitoring of GOOSE messages in real time		•	•	•
Emulation of GOOSE communications of predefined IEDs	•			
Immediate delivery of messages defined by the user without configuration files	•			
Changes tracking in GOOSE data and alarm generation		•		
GOOSE Publications	•			•
GOOSE Subscription		•	•	•
VLAN and priority	•	•	•	•
Historical records		•	•	

Potential of IEC 61850

- ✓ The sector's major solution providers are already counting the number of facilities where IEC 61850 systems have been successfully implemented by the thousands.
- ✓ The transformation from wired solutions to LAN networks has meant a significant boost in capacity for substation automation systems, which raises the need for a whole new series of competencies and tools.

Solutions geared towards:

System manufacturers, electric power companies, test labs, engineering firms, integrators, operators, maintenance businesses, etc.

GOOSE Conductor

G-Conductor is a software solution by CIRCE to quickly and flexibly create and send GOOSE messages in an IEC 61850 network.

G-Conductor enables GOOSE messages to be created and sent instantly through an IEC 61850 network. There are various functioning options: loading a CID file to emulate GOOSE communications, creating customised packages based on existing configurations or generating messages from scratch.

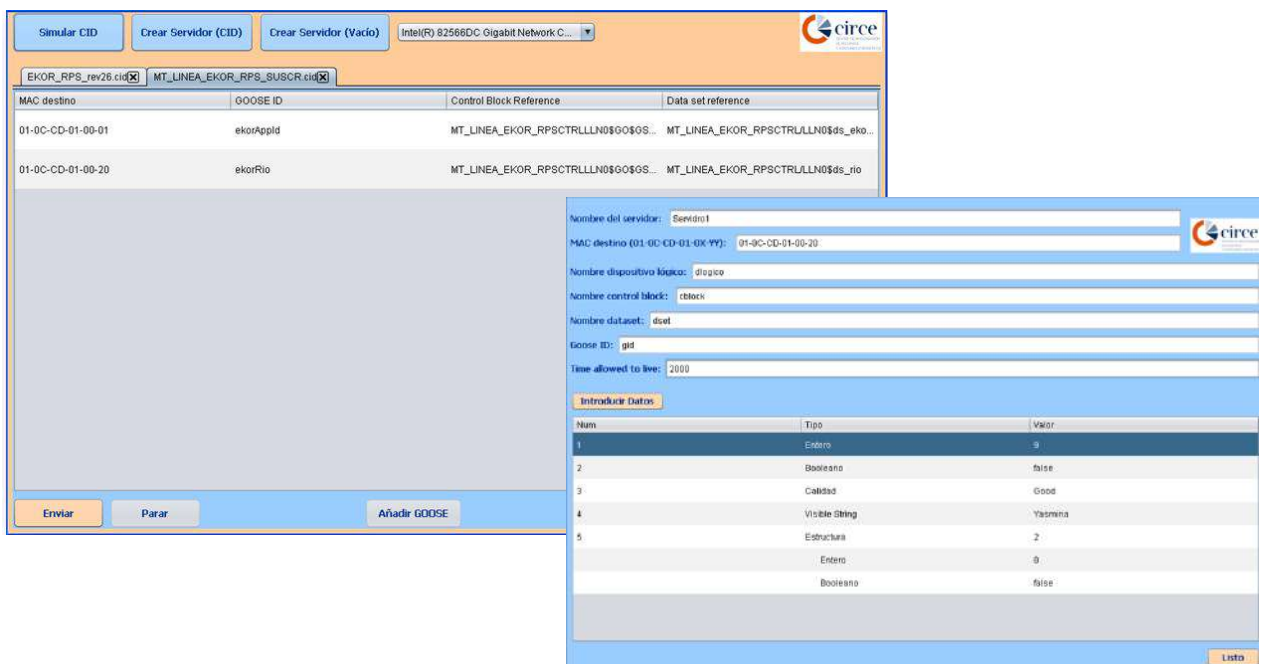
Users can also control all of the message fields and information, as it works with all kinds of IEC 61850 data. They can change the value of the information sent in real time, which allows them to carry out tests on real IEC 61850 systems and facilities, adapting the message to what is expected of the device without having to depend on a complete configuration file.

G-Conductor Functionalities

- Loading pre-configured GOOSE messages on a CID file.
 - Adding new GOOSE messages to an existing configuration.
- Creating GOOSE messages based on a specific CID data model.
 - Creating and sending GOOSE messages from scratch, without the need for an SCL file.
- Exporting SCL from the configurations generated.
- Creating data sets with members belonging to all kinds of data.
- Sending GOOSE messages according to the time scheme defined in IEC 61850.
- Emulating multiple servers simultaneously and independently.
- Changing the value of transmitted data in real time.

ADVANTAGES

- 1 No need to generate a complete IEC 61850 configuration to send new GOOSE messages.
- 2 Configuring interpreted labels that can be accessed by any user, regardless of their command of the standard.
- 3 Connecting and sending. Send with a single "click" of generated messages.
- 4 Independent from proprietary tools for message configuration.
- 5 Shorter IEC 61850 service commissioning and facility diagnosis times.
- 6 Less expert personnel required on-site.
- 7 No need to have a real device in order to use GOOSE communication in the lab or perform tests.



The screenshot displays the G-Conductor software interface. At the top, there are buttons for 'Simular CID', 'Crear Servidor (CID)', and 'Crear Servidor (Vacio)', along with a network selection dropdown set to 'Intel(R) 82566DC Gigabit Network C...'. Below this, there are tabs for 'EKOR_RPS_rev26.cid' and 'MT_LINEA_EKOR_RPS_SUSCR.cid'. A table lists configuration entries with columns for MAC destino, GOOSE ID, Control Block Reference, and Data set reference.

Below the table, there are input fields for 'Nombre del servidor: Servidor1', 'MAC destino (01-00-CD-01-0X-YY): 01-00-CD-01-00-20', 'Nombre dispositivo lógico: diglice', 'Nombre control block: cblock', 'Nombre dataset: dsot', 'Goose ID: gid', and 'Time allowed to live: 2000'. An 'Introducir Datos' button is present.

A data table is shown with the following content:

Num	Tipo	Valor
1	Entero	3
2	Booleano	false
3	Cadena	Good
4	Visible String	Yazmina
5	Estructura	2
	Entero	0
	Booleano	false

At the bottom, there are buttons for 'Enviar', 'Parar', and 'Añadir GOOSE', and a 'Lista' button in the bottom right corner.

GOOSE Miner

G-Miner is a software solution developed by CIRCE for interpreted viewing and simple analysis of the GOOSE messages transmitted at an IEC 61850 facility.

G-Miner allows users to view and analyse the GOOSE messages that are being sent through an IEC 61850 network in detail. To make the information easier to read, messages can be grouped by data sets, and the changes in their elements visualised in real time. Users can define their own reusable text templates to label the data, which means they no longer need to be familiar with the standard's data model or the details of the facility's engineering or the system's configuration.

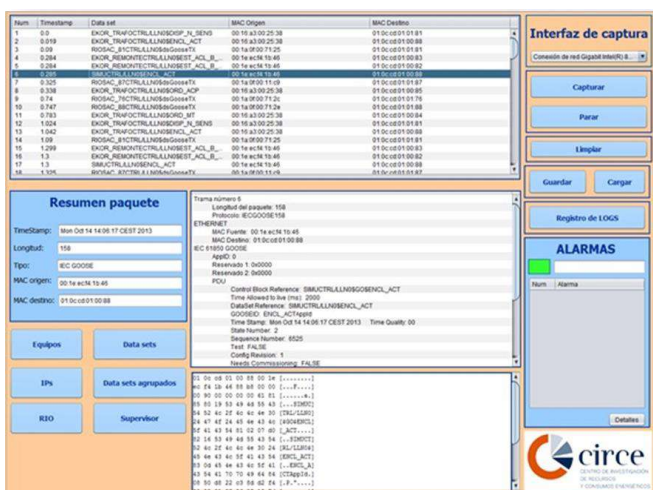
G-Miner also shows when the messages expire and monitors whether they are still being published or have been discontinued. As a result, all of the systems in the network can be supervised throughout the process. These features are enhanced by a record of data changes and alarms that simplify the process of detecting faults in the IEC 61850 network.

G-Miner Functionalities

- Displaying the GOOSE messages sent through the IEC 61850 network in real time.
 - Detailed analysis of all message fields.
 - Combining messages with the same data set.
 - Monitoring the status of GOOSE messages.
- Displaying changes in the data set values in real time.
- Monitoring the status of the systems that comprise the network (publishing, disconnecting, reconnecting).
 - Log records and alarms associated with the connections.
- Interpreted information rendered according to user specifications.
- Templates for saving and reusing customisations.

ADVANTAGES

- 1 No need to search specific messages in the display to identify and analyse changes in the facility.
- 2 Configuring interpreted labels that can be accessed by all users, regardless of their command of the standard.
- 3 Detecting faults in system communications.
- 4 Connecting and capturing. Immediate capture of messages when selecting the network interface.
- 5 Independent from proprietary message display tools. Compatible with all GOOSE suppliers and systems.
- 6 Shorter IEC 61850 service commissioning and facility diagnosis times.
- 7 Less expert personnel required on-site.



The screenshot shows the G-Miner software interface. On the left, a table lists captured messages with columns for 'Num', 'Timestamp', 'Data set', 'SMC Origin', and 'SMC Destino'. Below this is a 'Resumen paquete' (Packet Summary) section for a selected message, showing details like 'TimeStamp: Mon Oct 14 14:08:17 CEST 2013', 'Longitud: 158', and 'Tipo: IEC GOOSE'. The right side of the interface includes a 'Interfaz de captura' (Capture Interface) with buttons for 'Capturar', 'Parar', and 'Limpiar', and an 'ALARMAS' (Alarms) section with a 'Registro de LOGS' (Log Register) table.



This screenshot shows the interpreted view of GOOSE messages. The messages are displayed in a list with columns for 'SMC Destino', 'SMC Fuente', and 'Tipo'. A red box highlights a specific message. To the right, a configuration window is visible, showing fields for 'SMC Fuente', 'SMC Destino', and 'Tipo', along with a 'Registro de mensajes' (Message Register) table.



GOOSE Panorama

G-Panorama is a software solution by CIRCE for instant, standardised and interpreted display of the GOOSE messages in an IEC 61850 facility.

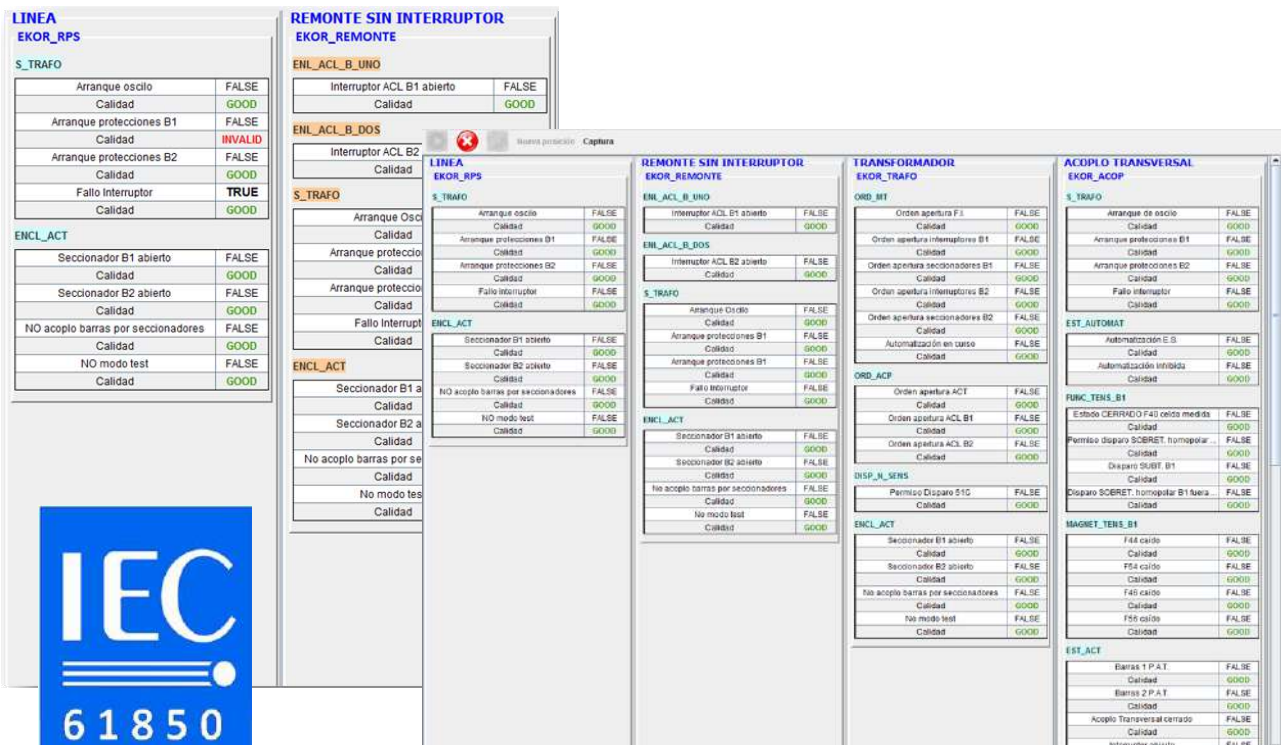
With G-Panorama, an IEC 61850 work scenario can be used for plug & play monitoring. A simple XML file can be used to define the desired scenario, from a lab setup to an operating substation. The configuration can show the positions, IEDs and format of the GOOSE messages sent by each system. With that, G-Panorama creates the right interface to render all of the data that are being sent through the IEC 61850 network. The application also allows users to easily detect whether messages are active by setting up alerts for disconnections or data quality issues. G-Panorama reveals the IEC 61850 facility's events instantly at a glance.

G-Panorama Functionalities

- Information uploaded immediately, with no need for the standard's SCL files.
- Independent from the various GOOSE reception options of the market's IEDs.
- Compatible with GOOSE communications from any supplier systems.
- Simple and reusable XML configuration for a fully customised description and interpretation of the facility.
- Verification of the validity date of the messages received.
- Simple viewing of everything that goes on in the facility on one screen.

ADVANTAGES

- Immediate monitoring of a facility, involving no communication configuration tasks.
- No need to search specific messages in the display to identify and analyse changes in the facility.
- Configuring interpreted labels that can be accessed by all users, regardless of their command of the standard.
- Detecting faults in system communications.
- Independent from proprietary message display tools.
- Shorter IEC 61850 service commissioning and facility diagnosis times.
- Less expert personnel required on-site.



The screenshot displays the G-Panorama software interface, which is organized into several panels for monitoring IEC 61850 data. The interface includes several tables with columns for data type, value, and quality. A central panel shows a 'REMONTE SIN INTERRUPTOR' status. A bottom-left panel features the IEC 61850 logo.

LINEA EKOR_RPS		
S_TRAFO		
Arranque oscilo	FALSE	
Calidad	GOOD	
Arranque protecciones B1	FALSE	
Calidad	INVALID	
Arranque protecciones B2	FALSE	
Calidad	GOOD	
Fallo Interruptor	TRUE	
Calidad	GOOD	
ENCL_ACT		
Seccionador B1 abierto	FALSE	
Calidad	GOOD	
Seccionador B2 abierto	FALSE	
Calidad	GOOD	
NO acoplo barras por seccionadores	FALSE	
Calidad	GOOD	
NO modo test	FALSE	
Calidad	GOOD	

REMONTE SIN INTERRUPTOR EKOR_REMONTE		
ENL_ACL_B_UNO		
Interruptor ACL B1 abierto	FALSE	
Calidad	GOOD	
ENL_ACL_B_DOS		
Interruptor ACL B2		
Calidad		
S_TRAFO		
Arranque Osc		
Calidad		
Arranque proteccio		
Calidad		
Arranque proteccio		
Calidad		
Fallo Interrupt		
Calidad		
ENCL_ACT		
Seccionador B1 abierto	FALSE	
Calidad	GOOD	
Seccionador B2 abierto	FALSE	
Calidad	GOOD	
NO acoplo barras por seccionadores	FALSE	
Calidad	GOOD	
NO modo test	FALSE	
Calidad	GOOD	
Seccionador B1 a		
Seccionador B2 a		
Calidad		
No acoplo barras por se		
Calidad		
No modo tes		
Calidad		

REMONTE SIN INTERRUPTOR EKOR_REMONTE		
ENL_ACL_B_UNO		
Interruptor ACL B1 abierto	FALSE	
Calidad	GOOD	
ENL_ACL_B_DOS		
Interruptor ACL B2 abierto	FALSE	
Calidad	GOOD	
S_TRAFO		
Arranque Oscilo	FALSE	
Calidad	GOOD	
Arranque protecciones B1	FALSE	
Calidad	GOOD	
Arranque protecciones B2	FALSE	
Calidad	GOOD	
Fallo Interruptor	FALSE	
Calidad	GOOD	
ENCL_ACT		
Seccionador B1 abierto	FALSE	
Calidad	GOOD	
Seccionador B2 abierto	FALSE	
Calidad	GOOD	
NO acoplo barras por seccionadores	FALSE	
Calidad	GOOD	
NO modo test	FALSE	
Calidad	GOOD	

TRANSFORMADOR EKOR_TRAFO		
ORD_B1		
Orden apertura F13	FALSE	
Calidad	GOOD	
Orden apertura interruptores B1	FALSE	
Calidad	GOOD	
Orden apertura seccionadores B1	FALSE	
Calidad	GOOD	
Orden apertura interruptores B2	FALSE	
Calidad	GOOD	
Orden apertura seccionadores B2	FALSE	
Calidad	GOOD	
Automatización en base	FALSE	
Calidad	GOOD	
ORD_ACP		
Orden apertura ACT	FALSE	
Calidad	GOOD	
Orden apertura ACL B1	FALSE	
Calidad	GOOD	
Orden apertura ACL B2	FALSE	
Calidad	GOOD	
DISP_M_SERV		
Permisos Disparo 51C	FALSE	
Calidad	GOOD	
ENCL_ACT		
Seccionador B1 abierto	FALSE	
Calidad	GOOD	
Seccionador B2 abierto	FALSE	
Calidad	GOOD	
no acoplo barras por seccionadores	FALSE	
Calidad	GOOD	
no modo test	FALSE	
Calidad	GOOD	

ACOPLO TRANSVERSAL EKOR_ACOF		
S_TRAFO		
Arranque de oscilo	FALSE	
Calidad	GOOD	
Arranque protecciones B1	FALSE	
Calidad	GOOD	
Arranque protecciones B2	FALSE	
Calidad	GOOD	
Fallo Interruptor	FALSE	
Calidad	GOOD	
EST_AUTOMAT		
Automatización B1	FALSE	
Calidad	GOOD	
Automatización Interbda	FALSE	
Calidad	GOOD	
FUNC_TENS_B1		
Estado CERRVIO F43 celda medida	FALSE	
Calidad	GOOD	
Permisos Disparo SOBRET. homopolar	FALSE	
Calidad	GOOD	
Disparo SOBRET B1	FALSE	
Calidad	GOOD	
Disparo SOBRET. homopolar B1 fuera	FALSE	
Calidad	GOOD	
MAGNET_TENS_B1		
F44 caido	FALSE	
Calidad	GOOD	
F54 caido	FALSE	
Calidad	GOOD	
F45 caido	FALSE	
Calidad	GOOD	
F55 caido	FALSE	
Calidad	GOOD	
EST_ACT		
Barras 1 P A T	FALSE	
Calidad	GOOD	
Barras 2 P A T	FALSE	
Calidad	GOOD	
Acoplo Transversal cerrado	FALSE	
Calidad	GOOD	
Interruptor abierto	FALSE	
Calidad	GOOD	

IED TESTER

IED Tester is a software solution by CIRCE for easy interaction with an IEC 61850 IED, offering fast and easy verification of GOOSE configurations.

The IED Tester tool was developed based on CIRCE's solutions for reading and sending GOOSE messages, and has been adapted to interact with a given device. It is used to define a specific screen on which to display all of the messages sent and received by the system in a unified way.

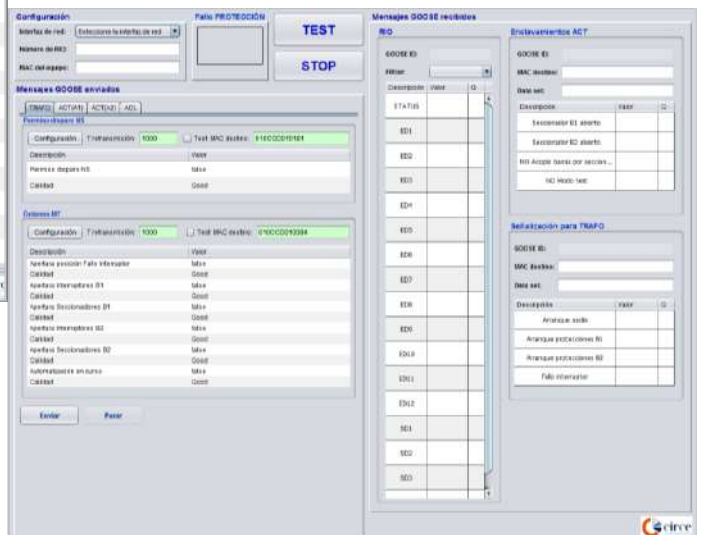
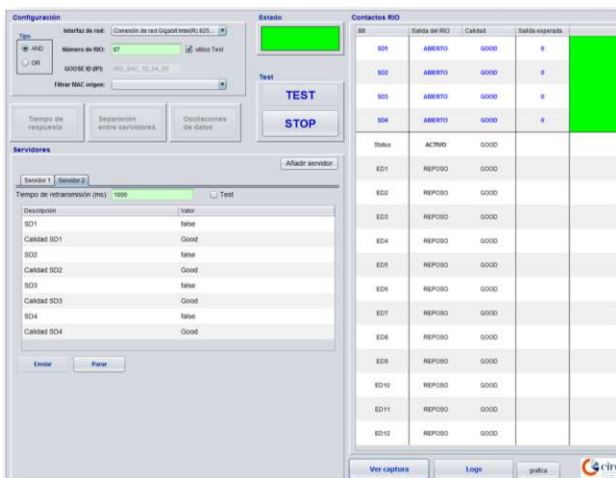
It also allows the user to generate the messages expected from the IED in order to analyse reactions in real time and view the changes in the information published, all on the same interface. One of its many advantages is its independence from the standard's SCL files, which speeds up laboratory work or the task of getting a system running. Some examples of the solution's successful implementation include its use in FAT and SAT tests in IEC 61850 booths or its customisation for RIO systems to capture GOOSE field signals.

IED TESTER Functionalities

- Straightforward configuration with predefined options.
- Reading the messages sent by a system and sending those expected to be received, on the same screen, applying the plug & play method.
- Emulating several GOOSE message sending systems and simulating the facility where the system will run.
- Changing the data sent by the servers in real time.
 - Calculating the expected value of the IED's behaviour and its messages. Comparison with the real value received.

ADVANTAGES

- ① Absolute optimisation of the validation processes linked to 61850 system GOOSE communications.
- ② No need for full configuration files according to the standard.
- ③ Information interpreted according to its functional nature.
- ④ Complementary to wired system tests, with instant response visualisation.
- ⑤ Connecting and capturing. Immediate capture of messages when selecting the network interface.
- ⑥ Shorter IEC 61850 service commissioning and system diagnosis times.
- ⑦ Less expert personnel required on-site.
- ⑧ Independent from the systems' proprietary configuration tools. Compatible with all manufacturers.



Online Course – IEC 61850 Standard

The list of qualifications offered by CIRCE includes an online course on the IEC 61850 standard for professionals in the sector (125 hours).

OBJECTIVE:

To equip attendants with the capabilities and technical skills they need to plan, analyse and maintain control and protection mechanism configurations for electric systems under IED 61850.

WHO FOR?

Professionals in the sector and anyone interested in broadening their knowledge of Substation Automation Systems and new communication technology in the electrical field.

SKILLS:

- Consolidating existing knowledge of electric system control and protection mechanisms.
- Becoming familiar with the structure, objectives and key technical aspects of the standard.
- Modelling the main elements of a substation according to the standard's criteria.
- Interpreting and adjusting CID files for different IED configurations.
- Deciding on and configuring the data issued by a system using IEC 61850 communication protocols.
- Broadening existing knowledge on LAN communication networks, focusing on electric substations and smart grids,
- Analysing and interpreting IEC 61850 communication protocol messages.

Programme

1. INTRODUCTION

Overall outline of the standard; substation control, protection and remote control systems; introduction to communication protocols, TCP/IP models and LAN networks.

2. STANDARD IEC 61850

Data models; IEC 61850 Communication Services and Protocols

3. IMPLEMENTATION

Configuration of IEDs, protection and control systems; case studies; and applications for smart grids and renewable power plants.

4. OVERVIEW OF REAL SOLUTIONS FOR SUBSTATIONS

Group E3: common Spanish specifications for IEC 61850 substations and case studies.

5. CONCLUSIONS

Appraisal, future branches of the standard and other applications.

Teaching Plan:

The course will be imparted through a virtual platform where students will find all of the learning material and other additional resources such as videos and useful references.

Students will also have access to a discussion forum and ongoing assistance from teachers, as well as a weekly online tutor session.

REFERENCES

CIRCE has built up considerable expertise regarding standard IEC 61850, having worked alongside such major companies as:



CIRCE has also carried out a series of R&D projects in this field:

- **IdEAS project** – R&D&I project, Collaboration Challenges Programme (2016); Interoperability of Substation Automation Systems.
- **Smart Substation** - Pilot project involving Endesa's hybrid MT booths under standard IEC 61850 at an installation in service in Barcelona.
- **Online and in-class training** on standard IEC 61850 for over 100 people from electricity companies, manufacturers and engineering firms.

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