



(Included with the base unit)



+

Additional Generation Group
4.5 kVA Generator-Motor Group+
Generator Protection Relay Module +
5 kW Motor Speed Controller +
Automatic Voltage Regulator.



+



① Unit: AEL-GPRE. Generator Protection Relay Trainer

Key features:

- **Advanced Real-Time SCADA.**
- **Open Control + Multicontrol + Real-Time Control.**
- **Specialized EDIBON Control Software based on LabVIEW.**
- **National Instruments Data Acquisition board (250 KS/s, kilo samples per second).**
- **Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.**
- **Capable of doing applied research, real industrial simulation, training courses, etc.**
- **Remote operation and control by the user and remote control for EDIBON technical support, are always included.**
- **Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).**
- **Designed and manufactured under several quality standards.**
- **Optional ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc. Apart from monitoring user's knowledge and progress reached.**
- **This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.**



For more information about Key Features, click here



ISO 9001: Quality Management (for Design, Manufacturing, Commercialization and After-sales service)



European Union Certificate (total safety)



Certificates ISO 14001 and ECO-Management and Audit Scheme (environmental management)



Certificate and Worlddidac Member

INTRODUCTION

Power generators represent the fundamental part of a power system. These machines supply power along hundreds of kilometers up to the demanded point. They are subject to all kind of abnormal conditions that may reduce its service time, with these machines are used different protection systems. In order to avoid possible excessive wear and irreversible damages

GENERAL DESCRIPTION

The Generator Protection Relay Trainer, AEL-GPRE has been designed by Edibon for the training at both the theoretical and practical levels in the field of high power generators with control and protection systems.

This trainer presents several levels of training to give the user full knowledge and experiences about the operation of advanced protection systems used in large power plants with electrical generators: a specific manual is included to study all theoretically aspects related to electrical generators such as electrical generators types, basic principles of generators operation, control and stand-alone generator operation, parallel generator operation with the national grid, types of protections used to protect these machines, sizing and protection relay settings. On the other hand, they are provided a series of modules for putting students' acquired knowledge into practice.

The AEL-GPRE trainer includes a series of modules that make it leadership in the market:

- The Generator Protection and Control Relay Unit: it is an industrial control and protection device of power generator groups with more than 150 configurable variables. The Relay Unit allows the user different access levels for the relay configuration. For example, the user can adjust the protection thresholds of overcurrent (50/51), over/under-voltage, over/under-frequency (81), inverse power, over/under-speed of the turbine (12), number of poles of the machine, nominal power, etc. In addition, for more advanced settings, it is possible to set the PID control system parameters under different operation conditions of the turbine-generator group. For example, when the generator is working in stand-alone or in parallel operation modes are used different PIDs. During commissioning of generator the provided software allows monitoring voltage and frequency PID signals, perturbations, analysis and real time settings.

Due to the versatility of the Generator Protection and Control Relay Unit, Edibon provides configured this device to work properly from scratch with the generator-motor group. In addition, it is provided a relay setting file to restore the relay to the initial configuration. On this way, the user can change any relay parameter and recovery the initial setting.

- Turbine Speed Controller: the trainer includes an advanced speed controller that can be controlled manually or automatically. After manual control is selected, the user can control the turbine speed through a potentiometer provided in this module. If the user selects automatic control mode, the Generator Protection and Control Relay will control the turbine with an analog signal of 0-10V. On this way, the user can study the operation of the complete system working autonomously, as a real power station works, or he can take the control of the installation to study the effects of the speed change of the turbine in the electrical system.

- Automatic voltage regulator: this device is designed for manual and automatic control of the current excitation of the synchronous generator. The regulator has a switch that allows the user to select the control mode. If manual control mode is selected, the current excitation of the synchronous generator can be controlled manually with a potentiometer and the effects of the generator output voltage can be seen. Automatic control mode allows the Generator Protection and Control Relay Unit to take the control of the current excitation. On this way, the user can study the operation of the complete system working autonomously, as a real power station works, or he can take the control of the installation to study the effects of the excitation change of the synchronous generator in the electrical system.

- Faults simulation module: this module allows injecting real short circuits in the electrical generator to study the effects of these short circuits in the machine. Thus can be analyzed the response of the Generator Protection and Control Relay. The faults module has a selector, which allows the user to configure previously the kind of the fault to be injected: three-pole, two-pole, two-pole to ground and single-pole short circuits. All these faults can be configured with and without fault impedance. Finally, this module has a push-button to inject the fault.

- Network Analyzer Unit with Data Acquisition: This device allows measuring all electrical parameters of the synchronous generator such as phase and line voltages, line currents, active, reactive and apparent powers, frequency, harmonics, etc.

- Three-Phase bank of Commutable Resistors Module: this module is designed in order to carry out local consumption of the generated energy by the synchronous generator.

General Description

Optional modules:

- Differential protection relay module: this device allows protecting the generator against differential internal electrical faults.
- Rotor earth-fault protection module.
- Generator-Motor Group + Generator Protection and Control Relay Unit: they are additional equipment, which are required to couple several parallel generators to study load sharing, electrical service restoration after a black-out, etc.

The AEL-GPRE includes the following modules:

- N-ALI01. Industrial Main Power Supply.
- N-ERP-PGC-01. Generator Protection Relay Module.
- N-VVCA5K. 5 kW Motor Speed Controller.
- N-AVR/P. Automatic Voltage Regulator.
- N-EALD. Network Analyzer Unit with Computer Data Acquisition.
- N-CAR35T3. Three-Phase Bank of Commutable Resistors Module.
- N-ERP-MF01. Digital Fault Simulation Module.
- GMG4.5K3PH. 4.5 kVA Generator-Motor Group.

Optional modules:

- N-ERP-PDF01. Differential Protection Relay Module.
- N-REP. Rotor earth-fault protection module.

Additional generation group:

The following modules and units are required to extend the practical possibilities for load sharing studies.

- N-ERP-PGC-01. Generator Protection Relay Module.
- N-VVCA5K. 5 kW Motor Speed Controller.
- N-AVR/P. Automatic Voltage Regulator.
- GMG4.5K3PH. 4.5 kVA Generator-Motor Group.

Optional SCADA software:

- AEL-GPRE/CCSOF. Computer Control + Data Acquisition + Data Management Software.

Optional learning software:

In addition, Edibon provides optional software (AEL-GPRE/ICAI) to reinforce knowledge about this field. This software is formed by:

- ECM-SOF. EDIBON Classroom Manager (Instructor Software).
- ESL-SOF. EDIBON Student Labsoft (Student Software).

The application AEL-GPRE can be mounted on rack (option A) or on rail (option B):

Option A:

This application needs the following racks:

- N-RACK-A.
- N-RACK-B. (4 units)

Optionally the AEL-WBR. Electrical Workbench (Rack) can be supplied to place the rack/s.

Option B:

This application can be mounted on rail.

Optionally the AEL-WBC. Electrical Workbench (Rail) can be supplied to mount the modules.

Optionally this unit is supplied with the EDIBON Computer Control System (SCADA), and includes: The unit itself + Computer Control, Data Acquisition and Data Management Software Packages, for controlling the process and all parameters involved in the process.

With this unit there are several options and possibilities:

- Main items: 1, 3 and 4.
- Optional items: 2, 5, 6 and 7.

Let us describe first the main items (1 to 4):

① **AEL-GPRE. Unit.**

The trainer includes the following modules:

- **N-ALI01. Industrial Power Supply.**

Supply voltage: 400 VAC, 3PH+N+G.

ON-OFF removable key.

Output voltage connections:

Three-Phase + Neutral: 400 VAC.

Single-Phase: 230 VAC.

Three-Phase supply hose with IP44 3PN+E 32A 400V connecting plug.

Differential magnetothermal, 4 poles, 25A, 300mA AC 6KA.



N-ALI01

- **N-ERP-PGC01. Generator protection relay module.**

Generator protection relay module.

Single-phase supply voltage: 230 VAC.

"Island grid/parallel grid" control switch.

"Local/remote" control switch.

Manual control switches of the relay:

SW1, emergency stop.

SW2, automatic start of the motor-generator group.

SW3, protections reset pushbutton.

SW4, generator frequency control activation.

SW5, 52G1 synchronization circuit breaker closure manual permission.

State light indicators.

Alarm light indicators.

Synchronization safety key.

Emergency stop pushbutton.

SUB-D signals connector of 62 pins.

ON-OFF switch.

Connection terminals.

The N-ERP-PGC-01 generator protection relay:

Enables to connect up to 16 diesel generators in parallel-island with distribution of active and reactive load and start/stop in function of the load demand.

Enables to connect one generator in parallel with the grid.

Enables different switches control modes, such as opening, closing and synchronization.

Includes analogical outputs to control voltage and frequency regulators available in the market.

Three-phase measurement of the grid and generator voltage.

Three-phase measurement of the generator intensity and power.

Single-phase measurement of the grid intensity.

Protections:

Generator: max/mín-voltage (59/27), max/min-frequency (81O/U), voltage asymmetry, dead bus detection, overload (32), unbalance load (46), reverse power/reduce (32R/F), overcurrent time define curve (50/51), inverse time overcurrent (IEC255), fault ground (50N/51N), phases, breakers fault.

Motor: over/sub speed (12).

Mains: max/min-voltage (59/27), max/min-frequency (81O/U), vector surge.



N-ERP-PGC01

- **N-WCA5K. Speed control of the 5KW motor.**

AC 5KW motors control module.

Three-phase supply voltage: 400VAC + N.

Rated power: 5KW.

Motor speed control potentiometer.

ON-OFF control switch.

Local/remote control switch.

Signals connector SUB-D of 62 pins.

ON-OFF switch.

Connection terminals.



N-WCA5K

- **N-AVR/P. Automatic voltage regulator.**

- Generator excitation regulator.
- Local/remote control switch.
- Manual/automatic control switch of the excitation in local mode.
- Excitation current manual control potentiometer.
- ON-OFF switch.
- Connection terminals.
- Communication connector SUB-D of 62 pins.



N-AVR/P

- **N-EALD. Network Analyzer Unit with Computer Data Acquisition.**

- ON-OFF switch.
- Supply voltage: 400 VAC.
- Input terminals: Input connection with the measurement point.
- Output terminals: Output connection with the measurement point.
- Digital outputs: Three digital outputs are used for pulses or alarms, or for combining both.
- RS-485 Communication port.
- Fuses: 3x10 A.
- Network Analyzer Display. It shows:
 - Active, reactive and apparent power.
 - Active, reactive and apparent energies.
 - Lines and phase currents.
 - Line and phase voltages.
 - Frequencies.
 - Power Factor.



N-EALD

- **N-CAR35T3. Three-phase bank of commutable resistors module.**

- Three phase bank of commutable resistors module.
- Three sliding load switches.
- Three three-phase commutable banks of resistors of 150 ohms.
- ON-OFF switch.
- 3 stages x(3x1kW).



N-CAR19T3

- **N-ERP-MF01. Digital faults simulator module.**

- Faults injection module.
- Fault type preselector:
 - Three-phase fault.
 - Two-phase fault.
 - Two-phase to ground fault.
 - Single-phase fault.
- ON-OFF switch.
- Connection terminals.



N-ERP-MF01

- **GMG4.5K3PH. 4.5KW generator-motor group.**

- Motor-generator group coupled in an aluminium frame with wheels.
- Rated power of the generator: 4.5 KVA.
- Stator rated I: 6.5A.
- Excitation rated I: 4A.
- RPM: 3000 r.p.m.
- Motor rated power I: 5 KVA.
- Rated I: 7.2A.
- RPM: 3000 r.p.m.



GMG4.5K3PH

Optional modules:

• N-ERP-PDF01. **Differential protection relay.**

Differential protection relay module.
 Single-phase supply voltage: 230 VAC.
 Light indicator of TRIP.
 Differential protection.
 DB9 RS-232 communication connector.
 SUB-D signals connector of 62 pins.
 ON-OFF switch.
 Connection terminals.

Characteristics:

It protects two terminals transformers, generators, reactances and other power devices using a combination of differential, instantaneous and “inverse-time” overcurrent elements. The safety of the differential diagram is obtained by the following actions:

- Dual-slope percentage reduction.
- Second and forth harmonic blocking.
- Fifth harmonic blocking for transformer overexcitation.
- CT and transformers connection compensation.

• N-REP. **Rotor earth-fault protection module.**

Nominal voltage: 400V.
 Relay voltage: 24V.
 Contacts: 1 n.o., 1 n.c.
 Contact rating: 10A.
 Test button.
 Reset button.
 Two earth-fault signal lamps.



N-ERP-PDF01



N-REP

Additional generation group:

• N-ERP-PGC01. **Generator protection relay module.**

Generator protection relay module.
 Single-phase supply voltage: 230 VAC.
 “Island grid/parallel grid” control switch.
 “Local/remote” control switch.
 Manual control switches of the relay:
 SW1, emergency stop.
 SW2, automatic start of the motor-generator group.
 SW3, protections reset pushbutton.
 SW4, generator frequency control activation.
 SW5, 52G1 synchronization circuit breaker closure manual permission.

State light indicators.
 Alarm light indicators.
 Synchronization safety key.
 Emergency stop pushbutton.
 SUB-D signals connector of 62 pins.
 ON-OFF switch.
 Connection terminals.

The N-ERP-PGC-01 generator protection relay:

- Enables to connect up to 16 diesel generators in parallel-island with distribution of active and reactive load and start/stop in function of the load demand.
- Enables to connect one generator in parallel with the grid.
- Enables different switches control modes, such as opening, closing and synchronization.
- Includes analogical outputs to control voltage and frequency regulators available in the market.
- Three-phase measurement of the grid and generator voltage.
- Three-phase measurement of the generator intensity and power.
- Single-phase measurement of the grid intensity.

Protections:

- Generator: max/mín-voltage (59/27), max/min-frequency (81O/U), voltage asymmetry, dead bus detection, overload (32), unbalance load (46), reverse power/reduce (32R/F), overcurrent time define curve (50/51), inverse time overcurrent (IEC255), fault ground (50N/51N), phases, breakers fault.
- Motor: over/sub speed (12).
- Mains: max/min-voltage (59/27), max/min-frequency (81O/U), vector surge.



N-ERP-PGC01

- **N-WCA5K. Speed control of the 5KW motor.**

AC 5KW motors control module.
 Three-phase supply voltage: 400VAC + N.
 Rated power: 5KW.
 Motor speed control potentiometer.
 ON-OFF control switch.
 Local/remote control switch.
 Signals connector SUB-D of 62 pins.
 ON-OFF switch.
 Connection terminals.



N-WCA5K

- **N-AVR/P. Automatic voltage regulator.**

Generator excitation regulator.
 Local/remote control switch.
 Manual/automatic control switch of the excitation in local mode.
 Excitation current manual control potentiometer.
 ON-OFF switch.
 Connection terminals.
 Communication connector SUB-D of 62 pins.



N-AVR/P

- **GMG4.5K3PH. 4.5KW generator-motor group.**

Motor-generator group coupled in an aluminium frame with wheels.
 Rated power of the generator: 4.5 KVA.
 Stator rated I: 6.5A.
 Excitation rated I: 4A.
 RPM: 3000 r.p.m.
 Motor rated power I: 5 KVA.
 Rated I: 7.2A.
 RPM: 3000 r.p.m.



GMG4.5K3PH

- **All necessary cables to realize the practical exercises are included.**

The complete unit includes as well:

Advanced Real-Time SCADA.

Open Control + Multicontrol + Real-Time Control.

Specialized EDIBON Control Software based on LabVIEW.

National Instruments Data Acquisition board (250 KS/s, kilo samples per second).

Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.

Capable of doing applied research, real industrial simulation, training courses, etc.

Remote operation and control by the user and remote control for EDIBON technical support, are always included.

Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).

Designed and manufactured under several quality standards.

Optional ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc.

Apart from monitoring user's knowledge and progress reached.

This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.

② **AEL-GPRE/CCSOF. Computer Control + Data Acquisition + Data Management Software:**

The three softwares are part of the SCADA system.

Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. **Compatible with the industry standards.**

Registration and visualization of all process variables in an automatic and simultaneous way.

Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters.

Management, processing, comparison and storage of data.

Sampling velocity up to 250 KS/s (kilo samples per second).

It allows the registration of the alarms state and the graphic representation in real time.

Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

Open software, allowing the teacher to modify texts, instructions and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.

This unit allows the 30 students of the classroom to visualize simultaneously all the results and the manipulation of the unit, during the process, by using a projector or an electronic whiteboard.

③ **Cables and Accessories**, for normal operation.

④ **Manuals:**

This unit is **supplied with 7 manuals:** Required Services, Assembly and Installation, Control Software, Starting-up, Safety, Maintenance & Practices Manuals.

*References 1 to 4 are the main items: AEL-GPRE + AEL-GPRE/CCSOF + Cables and Accessories + Manuals are included in the minimum supply for enabling normal and full operation.



AEL-GPRE/CCSOF

EXERCISES AND PRACTICAL POSSIBILITIES TO BE DONE WITH THE MAIN ITEMS

- 1.- Study of generation power systems.
 - 2.- Analysis of the measurements of the power flows of the synchronous generator.
 - 3.- Analysis of the active and reactive power of the synchronous generator.
 - 4.- Automatic synchronization maneuvers of synchronous generator with the mains.
 - 5.- Study of the synchronous generator in island operation mode.
 - 6.- Study of the synchronous generator in grid parallel operation mode.
 - 7.- Study of excitation/voltage regulation of synchronous generator in island mode.
 - 8.- Study of turbine regulation (frequency control) in island mode.
 - 9.- Study of excitation/voltage regulation of synchronous generator in parallel grid operation mode.
 - 10.- Study of turbine regulation (frequency control) in parallel grid operation mode.
 - 11.- Study of the power factor regulation of synchronous generator in parallel grid operation mode.
 - 12.- Setting of time overcurrent protection.
 - 13.- Setting of unbalance load protection.
 - 14.- Setting of reverse power protection.
 - 15.- Setting of overvoltage and undervoltage protection.
 - 16.- Setting of PID voltage.
 - 17.- Setting of PID frequency voltage.
- Additional practical exercises possibilities with the optional modules:
- For differential protection relay studies (with optional module "N-ERP-PDF01"):
- 18.-Calculating protection operating values.
 - 19.-Fault recognition within the protection range.
 - 20.-Testing tripping and reset for faults occurring inside and outside the protection range.
 - 21.-Disconnection and de-excitation of the generator.
 - 22.-Measurement of the operating (pick-up) currents of the protection device for symmetrical and asymmetrical faults.
 - 23.-Comparison of measured values to set values.
- For rotor earth-fault relay studies (with optional module "N-REP"):
- 24.-Connection and testing of earth-fault relay.
 - 25.-Setting different rotor earth-faults.
- Additional practical exercises possibilities with the optional SCADA (AEL-GPRE/CCSOF).
- 26.- Remotely control of generation power systems.
 - 27.- Analysis with the SCADA software of synchronous generator power flows.
 - 28.- Analysis with SCADA software of active and reactive power of synchronous generator.
 - 29.- Remotely control of manual synchronization of synchronous generator with the mains.
 - 30.- Remotely control of automatic synchronization of synchronous generator with the mains.
 - 31.- Remotely control of synchronous generator in island grid operation mode.
 - 32.- Remotely control of synchronous generator in parallel grid operation mode.
 - 33.- Remotely control of excitation/voltage regulation of synchronous generator in island mode.
- Other possibilities to be done with this Unit:
- 34.- Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
 - 35.- The Computer Control System with SCADA allows a real industrial simulation.
 - 36.- This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.
 - 37.- This unit can be used for doing applied research.
 - 38.- This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
- Several other exercises can be done and designed by the user.

REQUIRED SERVICES

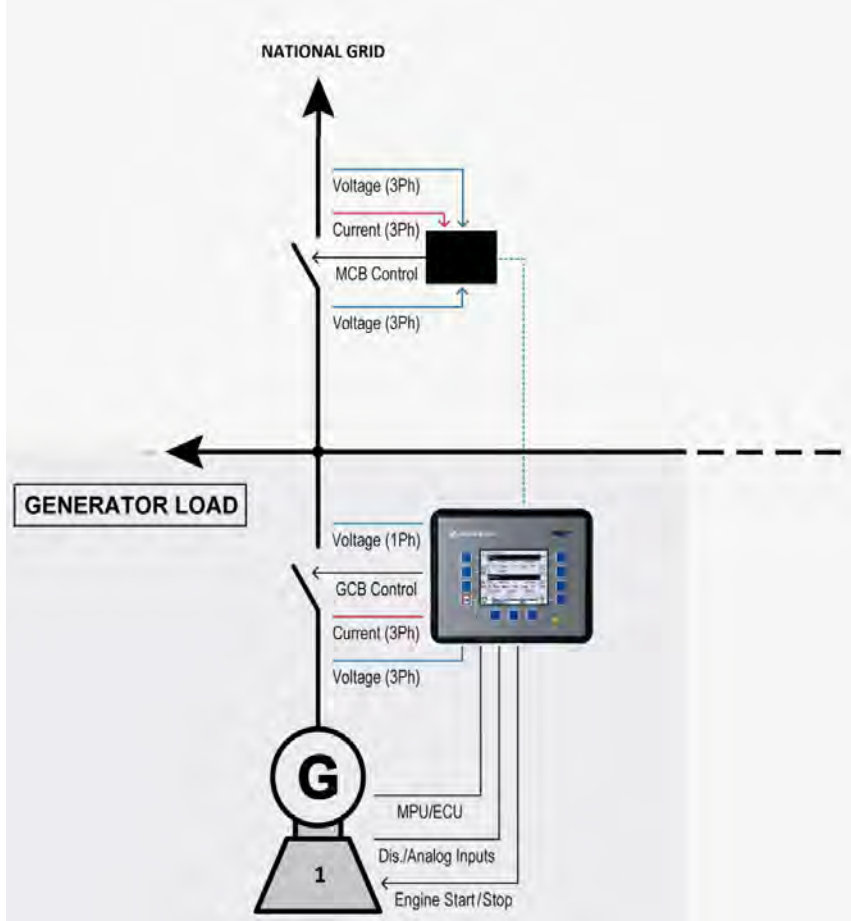
- Electrical supply: three-phase, 380V./50 Hz. or 208V./60 Hz., 20 Kw.
- Computer (PC).

DIMENSIONS AND WEIGHTS

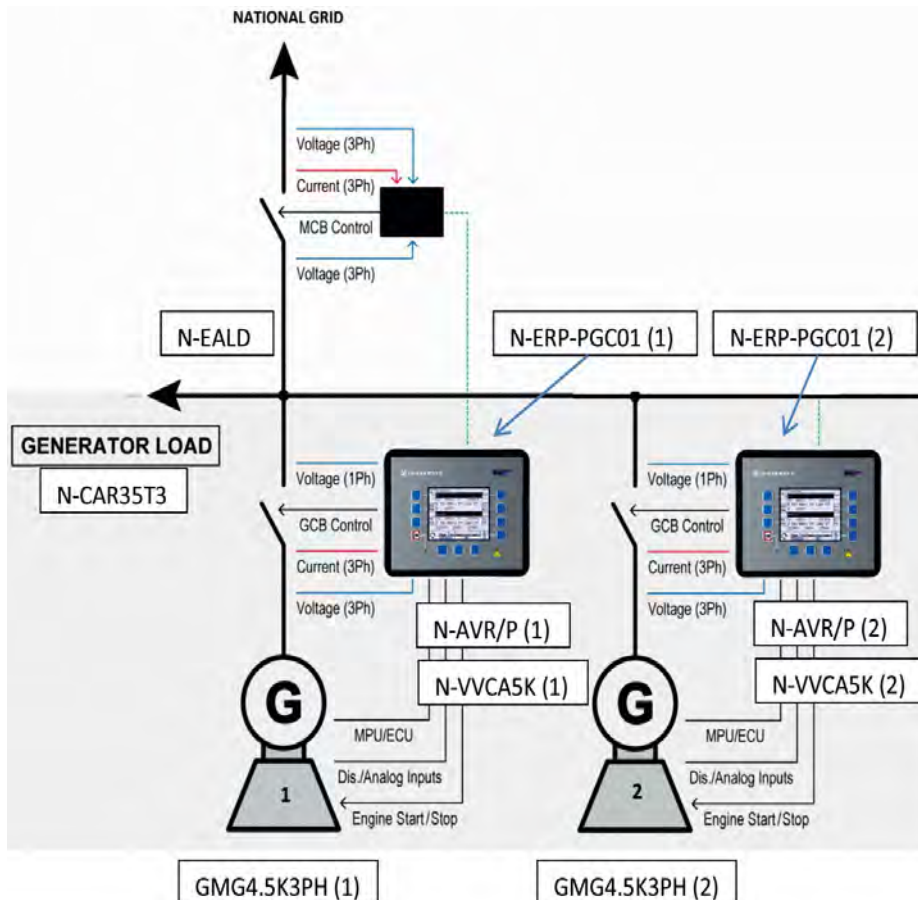
- AEL-GPRE:
- Dimensions: 1600 x 550 x 2000 mm. approx.
(62.99 x 21.65 x 78.73 inches approx.)
 - Weight: 50 Kg. approx.
(110 pounds approx.)

SOME RECOMMENDED CONFIGURATIONS

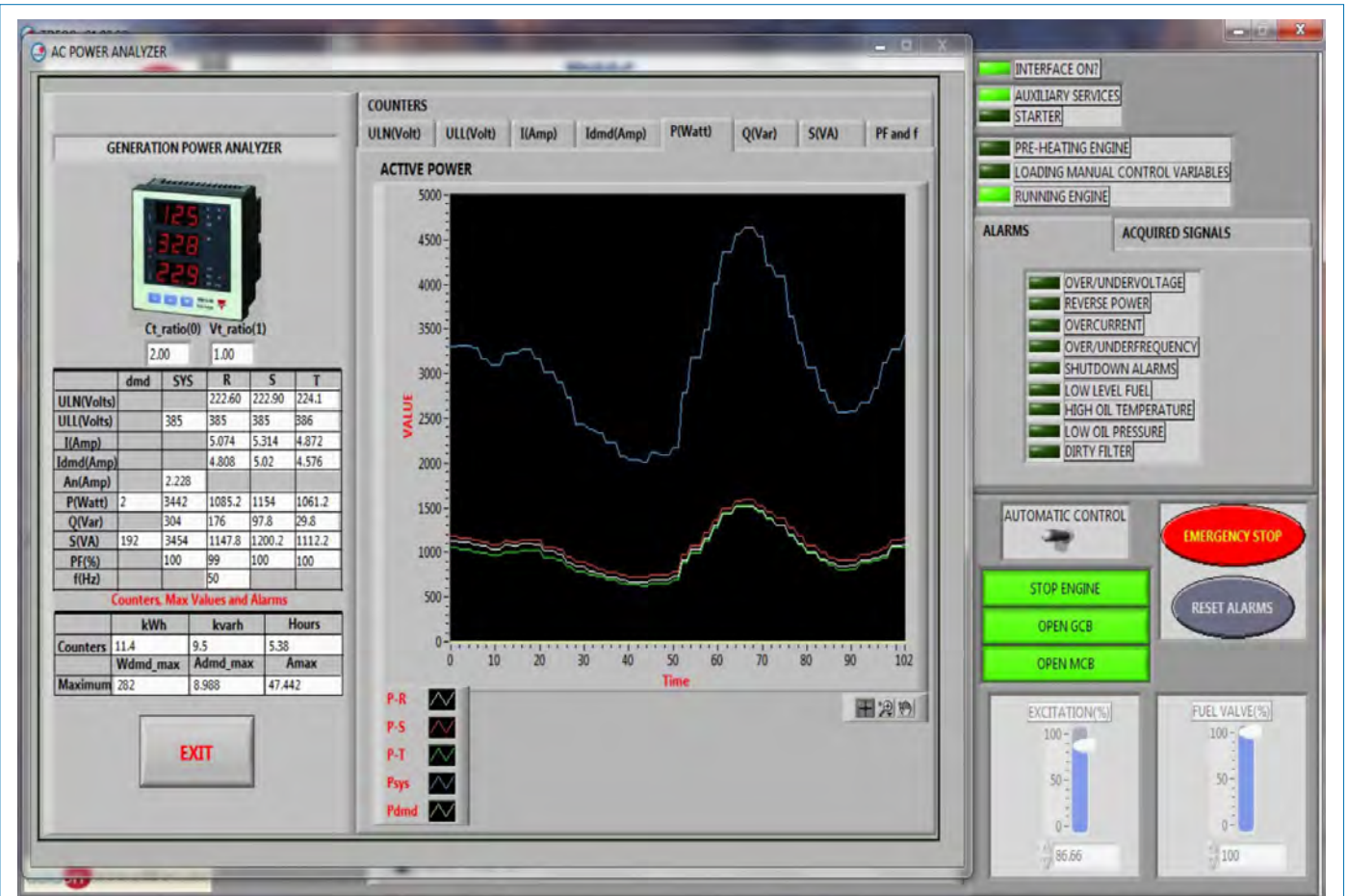
Example configuration 1. Minimum configuration with one Generator-Motor Group and one Generator Protection and Control Relay Unit.



Example configuration 2. Two Generator-Motor Groups and Two Generator Protection and Control Relay Units for load sharing studies.



SOME REAL RESULTS OBTAINED FROM THIS UNIT



Example of active power waves when the synchronous generator is synchronized with the grid.

Additionally to the main items (1, 3, 4) described, we can offer, as optional, other items 2 and from 5 to 7.

All these items try to give more possibilities for:

- a) Technical and Vocational Education configuration. (ICAI)
- b) Multipost Expansions options. (Mini ESN and ESN)

a) Technical and Vocational Education configuration

⑤ AEL-GPRE/ICAI. Interactive Computer Aided Instruction Software System.

This complete software package consists of an Instructor Software (EDIBON Classroom Manager -ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft -ESL-SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

This software is optional and can be used additionally to items (1 to 4).

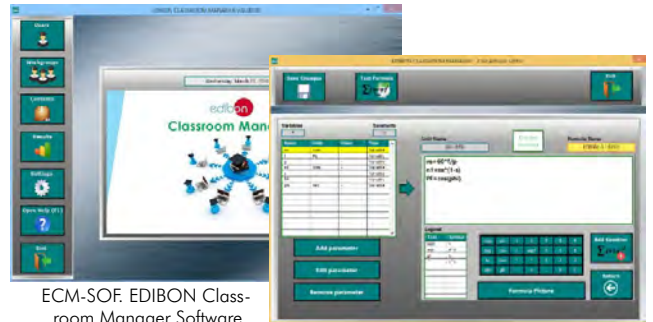
-ECM-SOF. EDIBON Classroom Manager (Instructor Software).

ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc... so the teacher can know in real time the level of understanding of any student in the classroom.

Innovative features:

- User Data Base Management.**
- Administration and assignment of Workgroups, Tasks and Training sessions.**
- Creation and Integration of Practical Exercises and Multimedia Resources.**
- Custom Design of Evaluation Methods.**
- Creation and assignment of Formulas & Equations.**
- Equation System Solver Engine.**
- Updatable Contents.**
- Report generation, User Progression Monitoring and Statistics.**

Instructor Software



ECM-SOF. EDIBON Classroom Manager Software Application main screen

ECAL. EDIBON Calculations Program Package - Formula Editor Screen



ERS. EDIBON Results & Statistics Program Package - Student Scores Histogram

ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

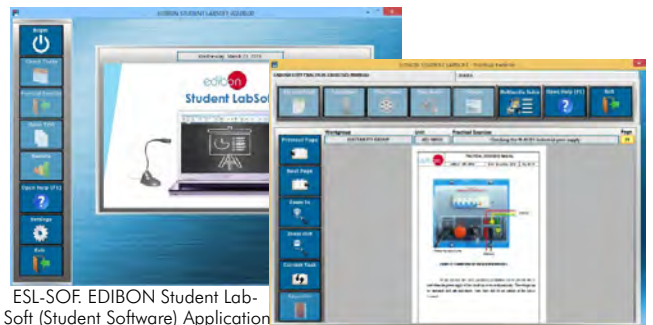
-ESL-SOF. EDIBON Student Labsoft (Student Software).

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.

Innovative features:

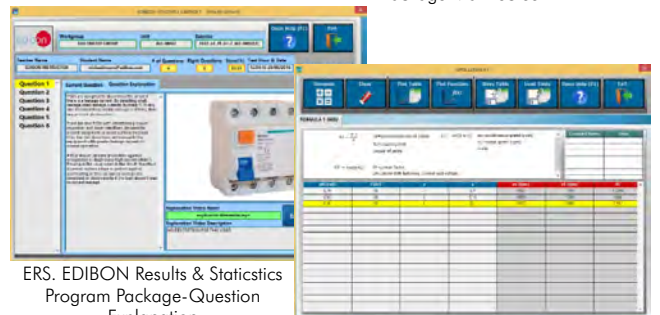
- Student Log-In & Self-Registration.**
- Existing Tasks checking & Monitoring.**
- Default contents & scheduled tasks available to be used from the first session.**
- Practical Exercises accomplishment by following the Manual provided by EDIBON.**
- Evaluation Methods to prove your knowledge and progression.**
- Test self-correction.**
- Calculations computing and plotting.**
- Equation System Solver Engine.**
- User Monitoring Learning & Printable Reports.**
- Multimedia-Supported auxiliary resources.**

Student Software



ESL-SOF. EDIBON Student Labsoft (Student Software) Application Main Screen

EPE. EDIBON Practical Exercise Program Package Main Screen



ERS. EDIBON Results & Statistics Program Package-Question Explanation

ECAL. EDIBON Calculations Program Package Main Screen

For more information see ICAI catalogue. Click on the following link:

www.edibon.com/products/catalogues/en/units/electricity/ICAI-Electricity/ICAI-Electricity.pdf

⑥ **Mini ESN. EDIBON Mini Scada-Net System.**

Mini ESN. EDIBON Mini Scada-Net System allows up to 30 students to work with a Teaching Unit in any laboratory, simultaneously.

It is useful for both, Higher Education and/or Technical and Vocational Education.

The Mini ESN system consists of the adaptation of any EDIBON computer controlled unit with SCADA integrated in a local network.

This system allows to view/control the unit remotely, from any computer integrated in the local net (in the classroom), through the main computer connected to the unit. Then, the number of possible users who can work with the same unit is higher than in an usual way of working (usually only one).

Main characteristics:

- It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA, connected in a local net.
- Open Control + Multicontrol + Real Time Control + Multi Student Post.
- Instructor controls and explains to all students at the same time.
- Any user/student can work doing "real time" control/multicontrol and visualisation.
- Instructor can see in the computer what any user/student is doing in the unit.
- Continuous communication between the instructor and all the users/students connected.

Main advantages:

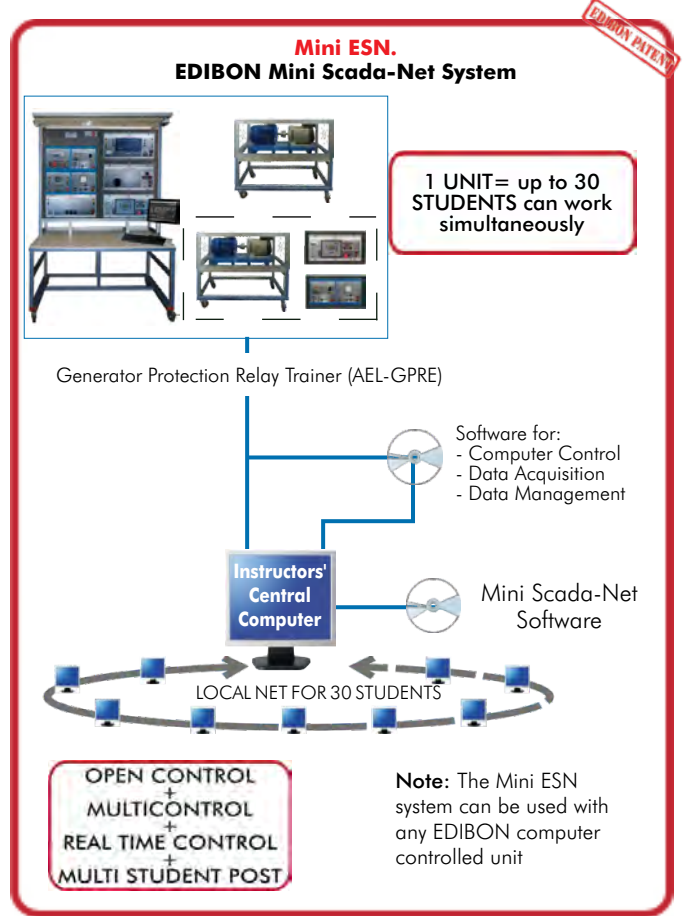
- It allows an easier and quicker understanding.
- This system allows you can save time and cost.
- Future expansions with more EDIBON Units.

For more information see Mini ESN catalogue. Click on the following link:

www.edibon.com/products/catalogues/en/Mini-ESN.pdf

⑦ **ESN. EDIBON Scada-Net System.**

This unit can be integrated, in the future, into a Complete Laboratory with many Units and many Students.



ORDER INFORMATION

Main items (always included in the supply)

Minimum supply always includes:

- ① **Unit: AEL-GPRE. Generator Protection Relay Trainer.**
- ③ **Cables and Accessories**, for normal operation.
- ④ **Manuals.**

*IMPORTANT: Under AEL-GPRE we always supply all the elements for immediate running as 1, 2, 3 and 4.

Optional items (supplied under specific order)

- ② AEL-GPRE/CCSOF. Computer Control + Data Acquisition + Data Management Software.
 - a) Technical and Vocational configuration
- ⑤ AEL-GPRE/ICAI. Interactive Computer Aided Instruction Software System.
 - b) Multipost Expansions options
- ⑥ Mini ESN. EDIBON Mini Scada-Net System.
- ⑦ ESN. EDIBON Scada-Net System.

① AEL-GPRE. Unit.

The trainer includes the following modules:

- N-ALI01. Industrial Power Supply.
 - Supply voltage: 400 VAC, 3PH+N+G.
 - ON-OFF removable key.
 - Output voltage connections:
 - Three-Phase + Neutral: 400 VAC.
 - Single-Phase: 230 VAC.
 - Three-Phase supply hose with IP44 3PN+E 32A 400V connecting plug.
 - Differential magnetothermal, 4 poles, 25A, 300mA AC 6KA.
- N-ERP-PGC01. Generator protection relay module.
 - Generator protection relay module.
 - Single-phase supply voltage: 230 VAC.
 - “Island grid/parallel grid” control switch.
 - “Local/remote” control switch.
 - Manual control switches of the relay:
 - SW1, emergency stop.
 - SW2, automatic start of the motor-generator group.
 - SW3, protections reset pushbutton.
 - SW4, generator frequency control activation.
 - SW5, 52G1 synchronization circuit breaker closure manual permission.
 - State light indicators.
 - Alarm light indicators.
 - Synchronization safety key.
 - Emergency stop pushbutton.
 - SUB-D signals connector of 62 pins.
 - ON-OFF switch.
 - Connection terminals.
 - The N-ERP-PGC-01 generator protection relay:
 - Enables to connect up to 16 diesel generators in parallel-island with distribution of active and reactive load and start/stop in function of the load demand.
 - Enables to connect one generator in parallel with the grid.
 - Enables different switches control modes, such as opening, closing and synchronization.
 - Includes analogical outputs to control voltage and frequency regulators available in the market.
 - Three-phase measurement of the grid and generator voltage.
 - Three-phase measurement of the generator intensity and power.
 - Single-phase measurement of the grid intensity.
 - Protections:
 - Generator: max/min-voltage (59/27), max/min-frequency (810/U), voltage asymmetry, dead bus detection, overload (32), unbalance load (46), reverse power/reduce (32R/F), overcurrent time define curve (50/51), inverse time overcurrent (IEC255), fault ground (50N/51N), phases, breakers fault.
 - Motor: over/sub speed (12).
 - Mains: max/min-voltage (59/27), max/min-frequency (810/U), vector surge.
- N-VVCA5K. Speed control of the 5KW motor.
 - AC 5KW motors control module.
 - Three-phase supply voltage: 400VAC + N.
 - Rated power: 5KW.
 - Motor speed control potentiometer.
 - ON-OFF control switch.
 - Local/remote control switch.
 - Signals connector SUB-D of 62 pins.
 - ON-OFF switch.
 - Connection terminals.
- N-AVR/P. Automatic voltage regulator.
 - Generator excitation regulator.
 - Local/remote control switch.
 - Manual/automatic control switch of the excitation in local mode.
 - Excitation current manual control potentiometer.
 - ON-OFF switch.
 - Connection terminals.
 - Communication connector SUB-D of 62 pins.
- N-EALD. Network Analyzer Unit with Computer Data Acquisition.
 - ON-OFF switch.
 - Supply voltage: 400 VAC.
 - Input terminals: Input connection with the measurement point.
 - Output terminals: Output connection with the measurement point.
 - Digital outputs: Three digital outputs are used for pulses or alarms, or for combining both.
 - RS-485 Communication port.
 - Fuses: 3x10 A
 - Network Analyzer Display. It shows:
 - Active, reactive and apparent power.
 - Active, reactive and apparent energies.
 - Lines and phase currents.
 - Line and phase voltages.
 - Frequencies.
 - Power Factor.
- N-CAR35T3. Three-phase bank of commutable resistors module.
 - Three phase bank of commutable resistors module.
 - Three sliding load switches.
 - Three three-phase commutable banks of resistors of 150 ohms.
 - ON-OFF switch.
 - 3 stages x(3x1kW).

Tender Specifications (for main items)

- N-ERP-MF01. Digital faults simulator module.
 - Faults injection module.
 - Fault type preselector:
 - Three-phase fault.
 - Two-phase fault.
 - Two-phase to ground fault.
 - Single-phase fault.
 - ON-OFF switch.
 - Connection terminals.
- GMG4.5K3PH. 4.5KW generator-motor group.
 - Motor-generator group coupled in an aluminium frame with wheels.
 - Rated power of the generator: 4.5 KVA.
 - Stator rated I: 6.5A.
 - Excitation rated I: 4A.
 - RPM: 3000 r.p.m.
 - Motor rated power I: 5 KVA.
 - Rated I: 7.2A.
 - RPM: 3000 r.p.m.
- N-ERP-PDF01. Differential protection relay.
 - Differential protection relay module.
 - Single-phase supply voltage: 230 VAC.
 - Light indicator of TRIP.
 - Differential protection.
 - Db9 RS-232 communication connector.
 - SUB-D signals connector of 62 pins.
 - ON-OFF switch.
 - Connection terminals.
 - Characteristics:
 - It protects two terminals transformers, generators, reactances and other power devices using a combination of differential, instantaneous and “inverse-time” overcurrent elements. The safety of the differential diagram is obtained by the following actions:
 - Dual-slope percentage reduction.
 - Second and forth harmonic blocking.
 - Fifth harmonic blocking for transformer overexcitation.
 - CT and transformers connection compensation.
- N-REP. Rotor earth-fault protection module.
 - Nominal voltage: 400 V.
 - Relay voltage: 24V.
 - Contacts: 1 n.o., 1 n.c.
 - Contact rating: 10 A.
 - Test button.
 - Reset button.
 - Two earth-fault signal lamps.

Additional generation group:

- N-ERP-PGC01. Generator protection relay module.
 - Generator protection relay module.
 - Single-phase supply voltage: 230 VAC.
 - “Island grid/parallel grid” control switch.
 - “Local/remote” control switch.
 - Manual control switches of the relay:
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 - SW5, 52G1 synchronization circuit breaker closure manual permission.
 - State light indicators.
 - Alarm light indicators.
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 - Emergency stop pushbutton.
 - SUB-D signals connector of 62 pins.
 - ON-OFF switch.
 - Connection terminals.
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 - Includes analogical outputs to control voltage and frequency regulators available in the market.
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 - Three-phase measurement of the generator intensity and power.
 - Single-phase measurement of the grid intensity.
 - Protections:
 - Generator: max/min-voltage (59/27), max/min-frequency (81O/U), voltage asymmetry, dead bus detection, overload (32), unbalance load (46), reverse power/reduce (32R/F), overcurrent time define curve (50/51), inverse time overcurrent (IEC255), fault ground (50N/51N), phases, breakers fault.
 - Motor: over/sub speed (12).
 - Mains: max/min-voltage (59/27), max/min-frequency (81O/U), vector surge.

Tender Specifications (for main items)

- N-WCA5K. Speed control of the 5KW motor.
AC 5KW motors control module.
Three-phase supply voltage: 400VAC + N.
Rated power: 5KW.
Motor speed control potentiometer.
ON-OFF control switch.
Local/remote control switch.
Signals connector SUB-D of 62 pins.
ON-OFF switch.
Connection terminals.
- N-AVR/P. Automatic voltage regulator.
Generator excitation regulator.
Local/remote control switch.
Manual/automatic control switch of the excitation in local mode.
Excitation current manual control potentiometer.
ON-OFF switch.
Connection terminals.
Communication connector SUB-D of 62 pins.
- GMG4.5K3PH. 4.5KW generator-motor group.
Motor-generator group coupled in an aluminium frame with wheels.
Rated power of the generator: 4.5 KVA.
Stator rated I: 6.5A.
Excitation rated I: 4A.
RPM: 3000 r.p.m.
Motor rated power I: 5 KVA.
Rated I: 7.2A.
RPM: 3000 r.p.m.

- All necessary cables to realize the practical exercises are included.

The complete unit includes as well:

Advanced Real-Time SCADA.

Open Control + Multicontrol + Real-Time Control.

Specialized EDIBON Control Software based on LabVIEW.

National Instruments Data Acquisition board (250 KS/s, kilo samples per second).

Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.

Capable of doing applied research, real industrial simulation, training courses, etc.

Remote operation and control by the user and remote control for EDIBON technical support, are always included.

Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).

Designed and manufactured under several quality standards.

Optional ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc.

Apart from monitoring user's knowledge and progress reached.

This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.

② AEL-GPRE/CCSOF. Computer Control +Data Acquisition+ Data Management Software:

The three softwares are part of the SCADA system.

Compatible with the industry standards.

Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters.

Management, processing, comparison and storage of data.

Sampling velocity up to 250 KS/s (kilo samples per second).

Calibration system for the sensors involved in the process.

It allows the registration of the alarms state and the graphic representation in real time.

Open software, allowing the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.

This unit allows the 30 students of the classroom to visualize simultaneously all the results and the manipulation of the unit, during the process, by using a projector or an electronic whiteboard.

③ Cables and Accessories, for normal operation.

④ Manuals:

This unit is supplied with 7 manuals: Required Services, Assembly and Installation, Control Software, Starting-up, Safety, Maintenance & Practices Manuals.

Exercises and Practical Possibilities to be done with the Main Items

- 1.- Study of generation power systems.
- 2.- Analysis of the measurements of the power flows of the synchronous generator.
- 3.- Analysis of the active and reactive power of the synchronous generator.
- 4.- Automatic synchronization maneuvers of synchronous generator with the mains.
- 5.- Study of the synchronous generator in island operation mode.
- 6.- Study of the synchronous generator in grid parallel operation mode.
- 7.- Study of excitation/voltage regulation of synchronous generator in island mode.
- 8.- Study of turbine regulation (frequency control) in island mode.
- 9.- Study of excitation/voltage regulation of synchronous generator in parallel grid operation mode.
- 10.- Study of turbine regulation (frequency control) in parallel grid operation mode.
- 11.- Study of the power factor regulation of synchronous generator in parallel grid operation mode.
- 12.- Setting of time overcurrent protection.
- 13.- Setting of unbalance load protection.
- 14.- Setting of reverse power protection.
- 15.- Setting of overvoltage and undervoltage protection.
- 16.- Setting of PID voltage.
- 17.- Setting of PID frequency voltage.

Additional practical exercises possibilities with the optional modules:

For differential protection relay studies (with optional module "N-ERP-PDF01"):

- 18.-Calculating protection operating values.
- 19.-Fault recognition within the protection range.
- 20.-Testing tripping and reset for faults occurring inside and outside the protection range.
- 21.-Disconnection and de-excitation of the generator.
- 22.-Measurement of the operating (pick-up) currents of the protection device for symmetrical and asymmetrical faults.
- 23.-Comparison of measured values to set values.

For rotor earth-fault relay studies (with optional module "N-REP"):

- 24.-Connection and testing of earth-fault relay.
- 25.-Setting different rotor earth-faults.

Additional practical exercises possibilities with the optional SCADA (AEL-GPRE/CCSOF).

- 26.- Remotely control of generation power systems.
- 27.- Analysis with the SCADA software of synchronous generator power flows.
- 28.- Analysis with SCADA software of active and reactive power of synchronous generator.
- 29.- Remotely control of manual synchronization of synchronous generator with the mains.
- 30.- Remotely control of automatic synchronization of synchronous generator with the mains.
- 31.- Remotely control of synchronous generator in island grid operation mode.
- 32.- Remotely control of synchronous generator in parallel grid operation mode.
- 33.- Remotely control of excitation/voltage regulation of synchronous generator in island mode.

Other possibilities to be done with this Unit:

- 34.- Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
 - 35.- The Computer Control System with SCADA allows a real industrial simulation.
 - 36.- This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.
 - 37.- This unit can be used for doing applied research.
 - 38.- This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
- Several other exercises can be done and designed by the user.

a) Technical and Vocational Education configuration

⑤ AEL-GPRE/ICAI. Interactive Computer Aided Instruction Software System.

This complete software package consists of an Instructor Software (EDIBON Classroom Manager -ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft -ESL-SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

-ECM-SOF: EDIBON Classroom Manager (Instructor Software).

ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc...so the teacher can know in real time the level of understanding of any student in the classroom.

Innovative features:

- User Data Base Management.
- Administration and assignment of Workgroup, Task and Training sessions.
- Creation and Integration of Practical Exercises and Multimedia Resources.
- Custom Design of Evaluation Methods.
- Creation and assignment of Formulas & Equations.
- Equation System Solver Engine.
- Updatable Contents.
- Report generation, User Progression Monitoring and Statistics.

-ESL-SOF: EDIBON Student Labsoft (Student Software).

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.

Innovative features:

- Student Log-In & Self-Registration.
- Existing Tasks checking & Monitoring.
- Default contents & scheduled tasks available to be used from the first session.
- Practical Exercises accomplishment by following the Manual provided by EDIBON.
- Evaluation Methods to prove your knowledge and progression.
- Test self-correction.
- Calculations computing and plotting.
- Equation System Solver Engine.
- User Monitoring Learning & Printable Reports.
- Multimedia-Supported auxiliary resources.

b) Multipost Expansions options

⑥ Mini ESN. EDIBON Mini Scada-Net System.

EDIBON Mini Scada-Net System allows up to 30 students to work with a Teaching Unit in any laboratory, simultaneously.

The Mini ESN system consists of the adaptation of any EDIBON Computer Controlled Unit with SCADA integrated in a local network.

This system allows to view/control the unit remotely, from any computer integrated in the local net (in the classroom), through the main computer connected to the unit.

Main characteristics:

- It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA, connected in a local net.
- Open Control + Multicontrol + Real Time Control + Multi Student Post.
- Instructor controls and explains to all students at the same time.
- Any user/student can work doing "real time" control/multicontrol and visualisation.
- Instructor can see in the computer what any user/student is doing in the unit.
- Continuous communication between the instructor and all the users/students connected.

Main advantages:

- It allows an easier and quicker understanding.
- This system allows you can save time and cost.
- Future expansions with more EDIBON Units.

The system basically will consist of:

This system is used with a Computer Controlled Unit.

- Instructor's computer.
- Students' computers.
- Local Network.
- Unit-Control Interface adaptation.
- Unit Software adaptation.
- Webcam.
- Mini ESN Software to control the whole system.
- Cables and accessories required for a normal operation.

* Specifications subject to change without previous notice, due to the convenience of improvement of the product.

REPRESENTATIVE



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