edibon
Technical Teaching Equipment

Computer Controlled
Reverse Osmosis/Ultrafiltration Unit
ROUC

EDIBON PATENT

Always included in the supply:

Teaching Technique used

SCADA. EDIBON Computer Control System

② Control Interface Box

③ Data Acquisition Board

④ Software for:
- Computer Control
- Data Acquisition
- Data Management

⑤ Cables and Accessories

⑥ Manuals

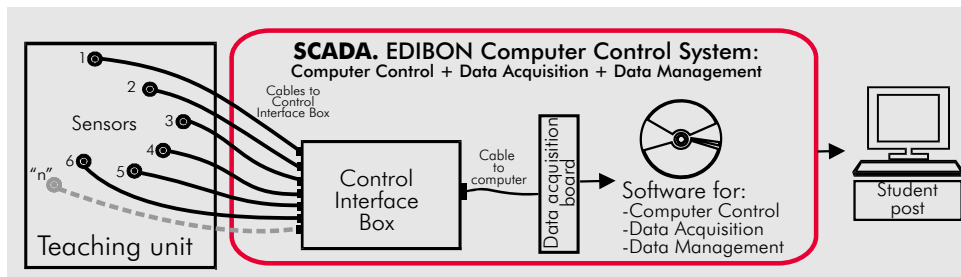Computer (not included in the supply)
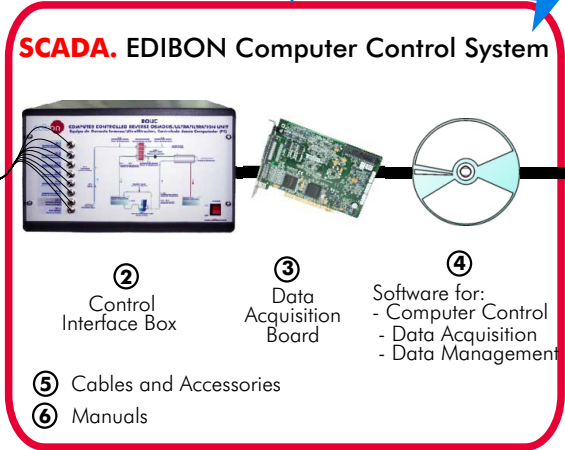
**OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL**

① Unit: ROUC. Reverse Osmosis/Ultrafiltration Unit

SCADA. EDIBON Computer Control System:
Computer Control + Data Acquisition + Data Management

Sensors
1
2
3
4
5
6
"n"

Teaching unit

Cables to Control Interface Box

Control Interface Box

Cable to computer

Data acquisition board

Software for:
-Computer Control
-Data Acquisition
-Data Management

Student post

DESCRIPTION

Laboratory Scale Computer Controlled Reverse Osmosis/Ultrafiltration Unit designed to study and to provide practical training in these downstream processing techniques.

As well as the processing of the whey, the membranes can be also used to demonstrate, for example: clarification and concentration of fruit juices, potabilization of water, pre-concentration of milk for cheese manufacturing, etc.

This unit is composed by a three head positive displacement pump. The pump motor is controlled by an inverter that allows obtaining different flows depending on the required separation process. Because it is a positive displacement pump, the obtained flow is proportional to the motor speed.

Therefore, the pump supplies the effluent to the two tubular membranes connected in series placed in the membrane module. This solution keeps moving in the inner part of the tube, the permeate flows from the inner part of the tube towards the outer one and the concentrate is obtained in the final extreme of the tubes.

The ROUC unit makes a filtration process by cross flow, which avoids the appearance of impurities that reduces the capacity of the system.

The effluent moved by the pump receives some heat from the pump so its temperature increases. The permeate is stored in a final product tank. The concentrate goes back to the initial tank in order to be used again as an effluent but, due to the increase of temperature, this concentrate passes through a heat plate exchanger.

You have to know two different variables of the effluent in order to do the separation practices through Reverse Osmosis and Ultrafiltration:

- Chemical composition of the fluid.

- Characteristics of the membrane to know which one you should use in the process you want to obtain: the Retention Character, which is defined as the allowed pass size and the Flow type that, in this case, consists on cross flow but it depends on the membrane system that has been used and its measurement depends on the required production.

This Computer Controlled Unit, is supplied with the EDIBON Computer Control System (SCADA), including: Control Interface Box + Data Acquisition Board + Computer Control and Data Acquisition Software, for controlling the process and the parameters involved.

PROCESS DIAGRAM AND ELEMENTS ALLOCATION

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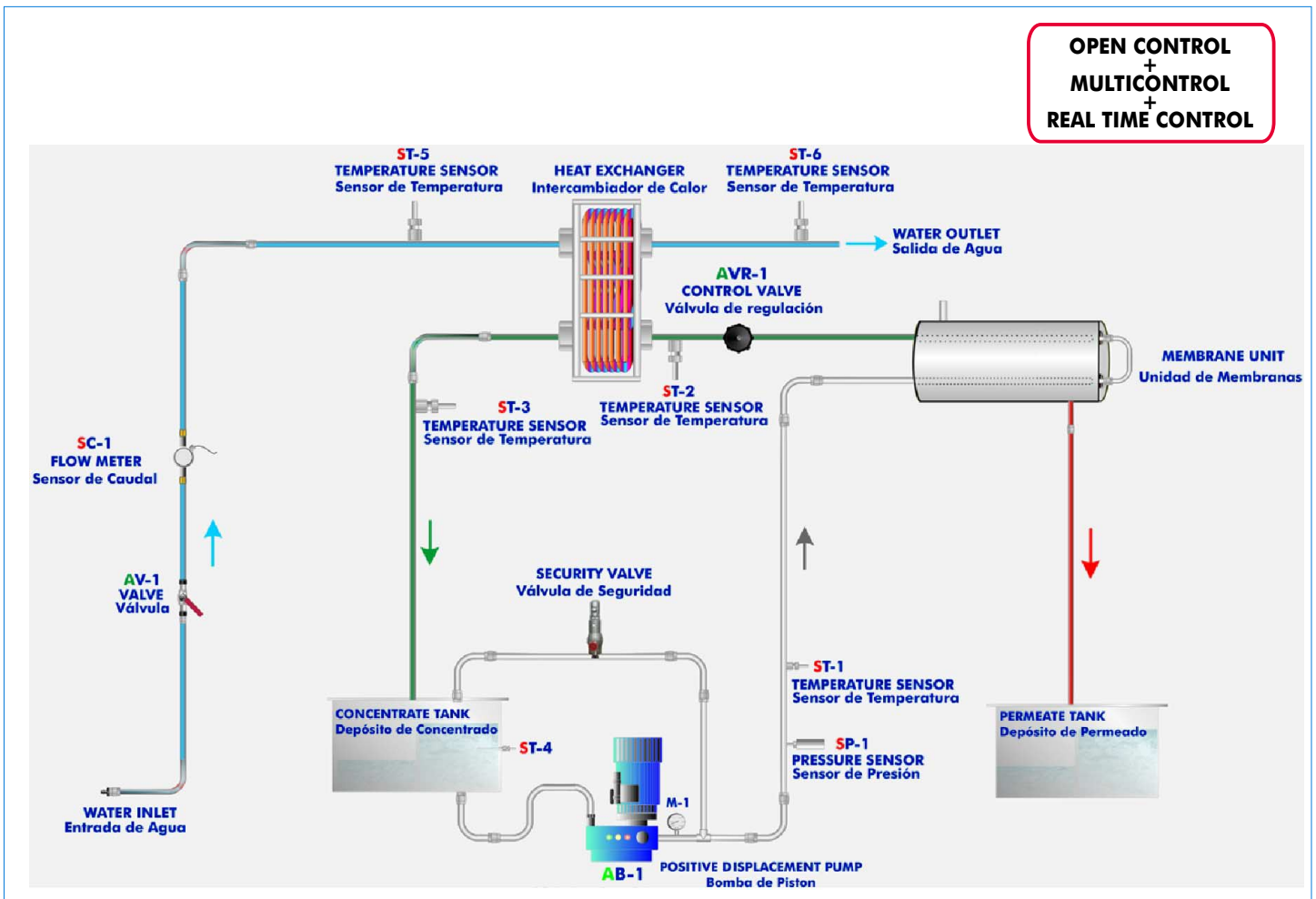
Items supplied as stardard

① ROUC. Unit:

Anodized aluminium structure and panels in painted steel (epoxi paint).

Main metallic elements in stainless steel.

Diagram in the front panel with similar distribution to the elements in the real unit.

Stainless steel feed tank (15 l. approx. capacity).

Three head positive displacement feed pump:

Maximum flow: 38 l./min,

Maximum pressure: 150 bar, maximum operation pressure: 55 bar.

This pump is used to feed product to the membrane module.

Flow and pressure adjustable. Variable speed control.

The pump has a relief valve to protect the unit.

Inverter that controls the pump motor.

Membrane module:

Two tubular membranes connected in series.

Membrane diameter: 12.5 mm.

Membrane area: 0.024 m².

Tubeside volume: 75 ml.

Maximum operation pressure: 55 bar.

Process control valve.

Plates heat exchanger for the concentrate.

Permeate stainless steel collecting tank (15 l. approx. capacity).

6 Temperature sensors, "J" type, range: -40 to 750°C.

Pressure sensor (0-100 bar).

Flow sensor (water inlet), range: 0-6 l/min.

2 Membranes of each model of the following are supplied:

RO01: Retention Character (99% NaCl), Process: Reverse Osmosis, Max. Pressure (45 bar).

UF02: Retention Character (20,000 Da), Process: Ultrafiltration, Max. Pressure (10 bar).

UF03: Retention Character (200,000 Da), Process: Ultrafiltration, Max. Pressure (15 bar).

The filtration membranes differ only in length and quantity from those installed in a real plant.

Rapid changeover from Reverse Osmosis to Ultrafiltration and back.

Easy cleaned and maintainance.

All elements in contact with the process fluid are constructed from hygienic design materials such as stainless steel, PTFE and silicone rubber.

The unit incorporates wheels for its mobility.

ROUC Unit

② ROUC/CIB. Control Interface Box :

Control interface box with process diagram in the front panel and with the same distribution that the different elements located in the unit, for an easy understanding by the student.

All sensors, with their respective signals, are properly manipulated for -10V. to +10V computer output. Sensors connectors in the interface have different pines numbers (from 2 to 16), to avoid connection errors. Single cable between the control interface box and computer.

The unit control elements are permanently computer controlled, without necessity of changes or connections during the whole process test procedure.

Simultaneously visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process. Real time curves representation about system responses. Storage of all the process data and results in a file. Graphic representation, in real time, of all the process/system responses.

All the actuators' values can be changed at any time from the keyboard allowing the analysis about curves and responses of the whole process. All the actuators and sensors values and their responses are placed in only one computer screen.

Shield and filtered signals to avoid external interferences.

Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process. Real time computer control for pumps, compressors, resistances, control valves, etc. **Open control** allowing modifications, at any time and in a real time, of parameters involved in the process simultaneously.

Three safety levels, one mechanical in the unit, other electronic in control interface and the third one in the control software.

ROUC/CIB

③ DAB. Data Acquisition Board:

PCI Data acquisition board (National Instruments) to be placed in a computer slot. Bus PCI.

Analog input: Number of **channels= 16** single-ended or 8 differential. **Resolution=16 bits**, 1 in 65536.

Sampling rate up to: 250 KS/s (Kilo samples per second). Input range (V)= ±10V.

Data transfers=DMA, interrupts, programmed I/0. Number of DMA channels=6.

Analog output: Number of **channels=2. Resolution=16 bits**, 1 in 65536. Maximum output rate up to: 833 KS/s.

Output range(V)= ±10V. Data transfers=DMA, interrupts, programmed I/0.

Digital Input/Output: Number of **channels=24 inputs/outputs.** D0 or DI Sample Clock frequency: 0 to 1 MHz.

Timing: **Counter/timers=2.** Resolution: Counter/timers: 32 bits.

DAB

④ ROUC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

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 simultaneously 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 250,000 data per second guaranteed. Calibration system for the sensors involved in the process.

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 to 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 at different work levels.

This unit allows that the 30 students of the classroom can visualize simultaneously all results and manipulation of the unit, during the process, by using a projector.

ROUC/CCSOF

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is **supplied with 8 manuals:** Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

✱ References 1 to 6: ROUC + ROUC/CIB + DAB + ROUC/CCSOF + Cables and Accessories + Manuals are included in the minimum supply, enabling a normal operation.
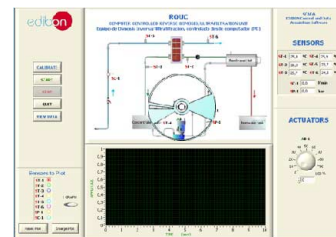
Complementary items to the standard supply

PLC. Industrial Control using PLC (7 and 8):

⑦ **PLC-PI. PLC Module:**
Circuit diagram in the front panel.
Front panel:
   Digital inputs(X) and Digital outputs (Y) block:
      16 Digital inputs, activated by switches and 16 LEDs for confirmation (red).
      14 Digital outputs (through SCSI connector) with 14 LEDs for message (green).
   Analog inputs block:
      16 Analog inputs (-10V. to + 10V.)(through SCSI connector).
   Analog outputs block:
      4 Analog outputs (-10V. to + 10V) (through SCSI connector).
   Touch screen:
      High visibility and multiple functions.
      Display of a highly visible status.
      Recipe function.
      Bar graph function.
      Flow display function.
      Alarm list.
      Multi language function.
      True type fonts.
Back panel:
   Power supply connector.
   Fuse 2A.
   RS-232 connector to PC.
Inside:
   Power supply outputs: 24 Vdc, 12 Vdc, -12 Vdc, 12 Vdc variable.
   Panasonic PLC:
      High-speed scan of 0.32 μsec. for a basic instruction.
      Program capacity of 32 Ksteps, with a sufficient comment area.
      Free input AC voltage(100 to 240 V AC).
      DC input:16 (24 V DC).
      Relay output: 14 (250 V A AC/2 A).
      High-speed counter.
      Multi-point PID control.
    Digital inputs/outputs and analog inputs/outputs Panasonic modules.
   Communication RS232 wire, to computer (PC).
⑧ **ROUC/PLC-SOF. PLC Control Software:**
    For this particular unit, always included with PLC supply.

PLC-PI

Items available on request

⑨ **ROUC/CAL. Computer Aided Learning Software (Results Calculation and Analysis)**.

⑩ **ROUC/FSS. Faults Simulation System.**

Software Main Screens

Main screen

Note: ST= Temperature sensor. SC= Flow sensor. SP= Pressure sensor. AB= Pump.

Examples of Sensors Calibration screens

Some typical exercises results

Pump working graph without concentrate refrigeration. The heat exchanger is switched off.
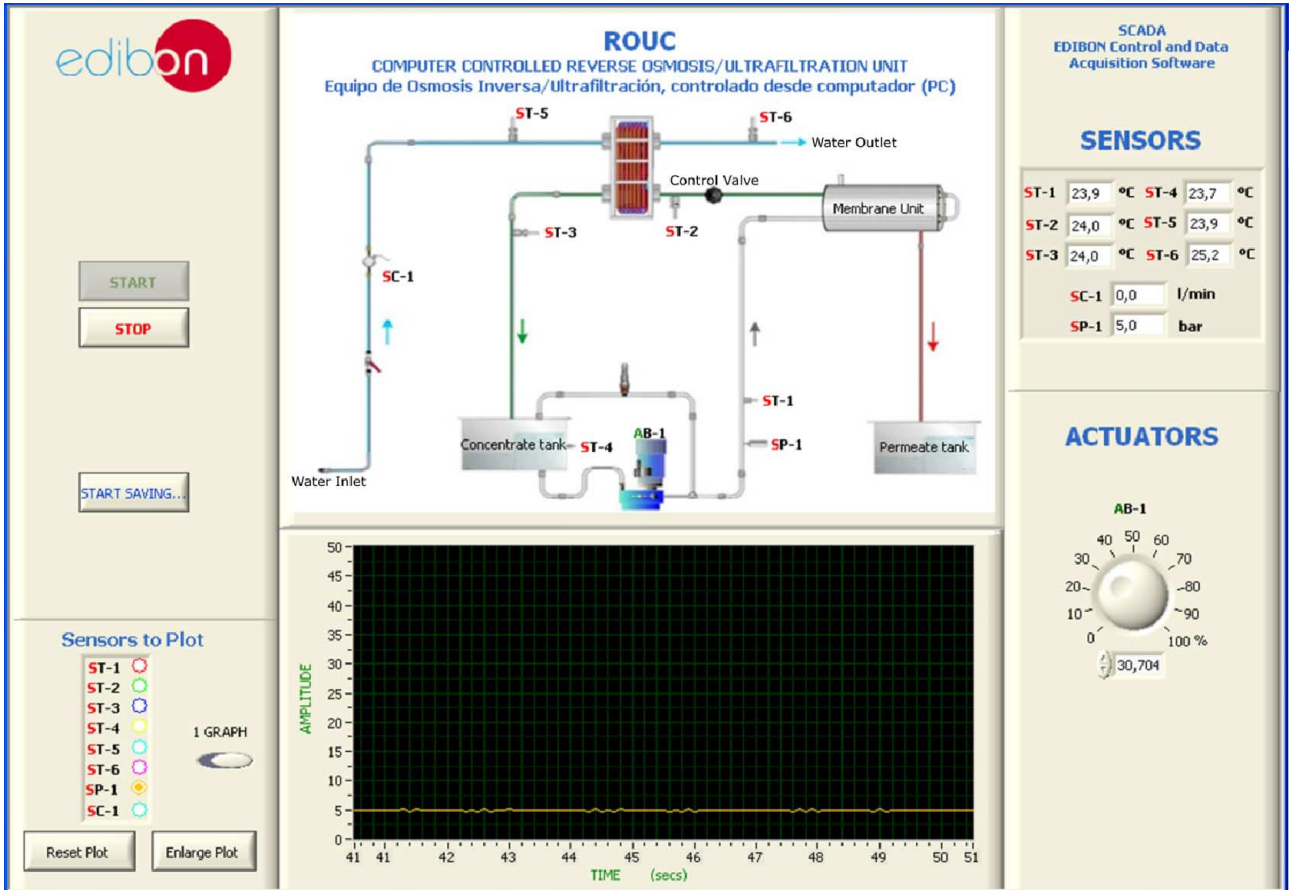
Some minutes later, after switch on the heat exchanger, the concentrate temperature is optimus for a reverse osmosis process.

Some typical exercises results

Membrane Module Software Protection

Besides of the protecctions includes in the unit, it also has software protection. If the unit reach high pressure (more than 50 bar) the software stops the process.

EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

1.- Practical training in ultrafiltration an reverse osmosis processing techniques.

2.- Protein standardisation in the production of fermented milk products such as concentration of skimmed milk for yoghurt production.

3.- Pre-concentration of milk for cheese manufacture.

4.- Concentration of fruit juices.

5.- Clarification of fruit juices.

6.- Water potabilization.

7.- Demonstration of the effect of varying the following process parameters on separation performance:
- Process pressure.
- Product flow rate.
- Process temperature.

8.- Applications of concentration, clarification, fractionation and standardization of milk, fruit juices, vegetables juices, etc.

9.- Treatment of effluent.

10.- Membrane cleaning and maintenance.

11.- Enzime, antibiotics and organic acids recovery in permeate.

Other possible practices:

12.- Sensors calibration.

Practices to be done by PLC Module (PLC-PI)+PLC Control Software:

13.- Control of the ROUC unit process through the control interface box without computer.

14.- Visualization of all the sensors values used in ROUC unit process.

15.- Calibration of all sensors included in ROUC unit process.

16.- Hand on of all the actuators involved in the ROUC unit process.

17.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).

18.- Simulation of outside actions, in the cases do not exist hardware elements (Example: test of complementary tanks, complementary industrial environment to the process to be studied, etc).

19.- PLC hardware general use and manipulation.

20.- PLC process application for the ROUC unit.

21.- PLC structure.

22.- PLC inputs and outputs configuration.

23.- PLC configuration possibilities.

24.- PLC program languages.

25.- PLC different programming standard languages (literal structured, graphic, etc.).

26.- New configuration and development of new process.

27.- Hand on an established process.

28.- To visualize and see the results and to make comparisons with the ROUC unit process.

29.- Possibility of creating new process in relation with the ROUC unit.

30.- PLC Programming Exercises.

31.- Own PLC applications in accordance with teacher and student requirements.

POSSIBILITIES OF OTHER AVAILABLE EXPANSIONS

Expansion 1:

⑪ **Mini ESN.** Multipost EDIBON Mini Scada-Net System

Teaching Technique used

1 UNIT = 30 STUDENTS can work simultaneously

Reverse Osmosis/Ultrafiltration Unit (ROUC)

Control Interface Box

Computer Control Software: Computer Control+ Data Acquisition+ Data Management

Teacher's Central Computer

Mini Scada-Net Software

30 Student Post

LOCAL NET

OPEN CONTROL + MULTICONTROL + MULTI STUDENT POST

Note: The Mini ESN system can be used with any EDIBON computer controlled unit.

Expansion 2:

⑫ **ESN.** Multipost EDIBON Scada-Net System

Teaching Technique used

Teaching Autonomous Pasteurization Unit (PADC)

Tray Drier (SBANC)

Reverse Osmosis/ Ultrafiltration Unit (ROUC)

Teaching Yogurt Incubator (IYDC)

Teaching Cream Separator (DSNC)

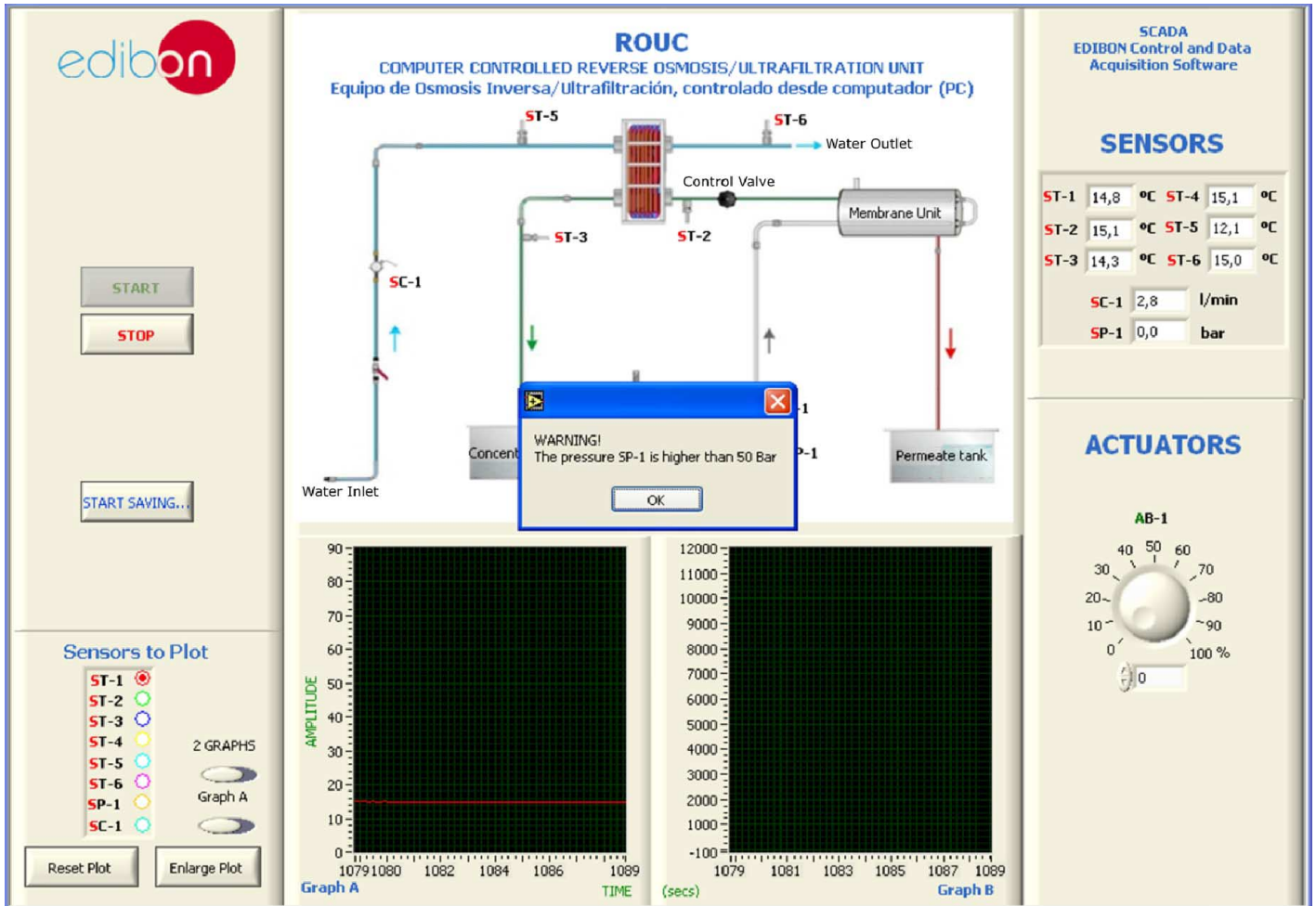"n" Any other additional computer controlled unit

PLC

PLC

PLC

PLC

PLC

"n" Control (1)Interface

"n" PLC

CENTRAL PLC

"REAL TIME MULTICONTROL SYSTEMS"

"SCADA" CENTRAL COMPUTER

Option

"ETDL" EDIBON TECHNICAL DISTANCE LEARNING SYSTEM

30 Student Post

LOCAL NET

30 students can work at the same time

OPEN CONTROL + MULTICONTROL + MULTI STUDENT POST

Note: The ESN system can use any EDIBON computer controlled unit.

ORDER INFORMATION

Items supplied as standard

Minimum configuration for normal operation includes:

① Unit: ROUC. Reverse Osmosis/Ultrafiltration Unit.

② ROUC/CIB. Control Interface Box.

③ DAB. Data Acquisition Board.

④ ROUC/SOF. Computer Control + Data Acquisition + Data Management Software.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals.

* **IMPORTANT: Under ROUC we always supply all the elements for immediate running as 1, 2, 3, 4, 5 and 6.**

Complementary items to the standard supply

PLC. Industrial Control Using PLC (7 and 8):

⑦ PCL-PI.PLC Module.

⑧ ROUC/PLC-SOF. PLC Control Software.

⑨ ROUC/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request).

⑩ ROUC/FSS. Faults Simulation System. (Available on request).

Expansions

⑪ Mini ESN. Multipost EDIBON Mini Scada-Net System.

⑫ ESN. Multipost EDIBON Scada-Net System.

-Electrical supply for the unit: 3-phase, 380V./50Hz or 220V./60 Hz.

-Water supply and drainage.

-Computer (PC).

ROUC. Unit :	-Dimensions: 800 x 800 x 1000 mm. approx.
	-Weight: 180 Kg. approx.
Control Interface Box:	-Dimensions: 490 x 330 x 310 mm. approx.
	-Weight: 10 Kg. approx.
PLC Module (PLC-PI):	-Dimensions: 490 x 330 x 310 mm. approx.
	-Weight: 30 Kg. approx.

✻ Specifications subject to change without previous notice, due to the convenience of improvements of the product.

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REPRESENTATIVE: