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Abstract
This deliverable describes the final stage of integration of the EOLI system within the life of the project. The general approach is outlined: two real physical pilot plants have been used for testing purposes. Other three plants out of Europe, the IbTech pilot plant in Mexico and the two lab plants at UU have been logged to the EOLI remote server to test and to demonstrate the potentialities and capability of the EOLI system in order to integrate the management of data from several plants.
Since this deliverable describes the final version of the EOLI local and remote software, it takes the form of a user guide to the software, illustrating all the functionalities that has been developed and implemented. The two software packages have been developed to be modular: addition of a sensor, an actuator, a software sensor, etc. are straightforward. Customisability of such a complex system was also a basic requirement: the implementation at the two pilot plants (ENEA and INRA) was used as a benchmark to test this requirement.

Remote software connection available from:
http://82.190.245.149/eoli

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Introduction

This deliverable presents a detailed description of the final version of the EOLI software. The earlier deliverable D8.3, 'Software main Frame able to integrate and manage the system', described the designed architecture and the implementation for the integrated system, developed on the basis of the specifications produced earlier in the project. As such, it was concerned with the first functioning EOLI system produced in the project and describes in some detail the architecture and the hardware and software implementation of the middleware and integrated systems.

This report describes in details how this monitoring and control software, composed by two different packages, the local software and the remote software, works and how it can directly and remotely interact with a plant. The present deliverable focuses more specifically on the graphical user interfaces and on the aspects related to the modularity, the plug and play installation and the use of the two software packages.

Within the project, there are several wastewater treatment plants that are being fitted with the EOLI system, adapted to their individual needs. These are the project's integrated systems. Integration means the setting up and basic testing of the EOLI modules on a SBR plant site, within the framework - the middleware - that allows them to communicate with each other and with the SBR process itself. The integration activity involves two real physical plants with the aim of validating the reliability and customisability of the system: the pilot scale plant at ENEA (Italy), and the pilot scale plant at INRA (France). These plants have very different characteristics, and thus it is a strong test for the EOLI approach to be able to integrate them all using the same framework.

The whole integrated system produced at the end of the project is characterised by the high level of modularity pursued for the integration that makes it possible to configure, to enrol, to enable or to disable all the several components: so the system can be applied at plant of different size, under different sensors network configurations. The experience from the installation, running and maintenance at two different pilot plants, the ENEA and the INRA ones, confirm this result. The full customisability, that was a key requirement for the development of the system, is a consequence of this high and reliable modularity.

In order to test and to demonstrate the potentialities and capability of the EOLI system as far as the data management and integration, other three plants located out of Europe, the IbTech full scale plant in Mexico and the two lab plants at UU have been logged to the EOLI remote server.

These plants have to be considered as examples of architectures compliant with the EOLI software supervision system, equipped with monitoring and control systems built up with off the shelf solution. This enforces the policy for exploitation and dissemination of the results of the EOLI project: the software main frame and the whole monitoring and control systems developed provide general features and capabilities that are customisable to many other types of EOLI compliant installations.

In this document the two software packages, the local software and the remote software, developed for the local and remote management of the whole integrated system will be described. The basic features of these two packages have been the object of the integration and validation activity at the two pilot plants: they will be presented by way of the description of the graphical user interfaces and of the tools, based on panels, menu and controls, they provide to the operator, both the local and the remote one.
Most of these features and the functionalities reported and described in the paper can be considered basic for the modularity of the two software packages, in the sense that through them the operator, both at local and remote level, is provided with a real capability to configure and to customise the whole integrated system with no constraints concerning the characteristics and size of the plant.

This document can be used as a user guide to rapidly install and run the two software packages, the local software and the remote software, at a plant site, so that to enrol and to integrate it into the EOLI system.

SPES will produce documentation (handbook and online guide for the users). It is also planned to have a tutorial/training session with the potential users.

The remote connection to the available plants can be accessed from:
http://82.190.245.149/eoli

The structure of the deliverable follows the sequence reported below.

- Section 1 recalls the basics features of the integrated systems in terms of hardware and software architecture.
- Section 2 describes the plants that have been integrated. This serves simply as a summary and for setting the context—for example, to show the diversity that the EOLI system can handle.

- Section 3 outlines the local software functionalities that have been implemented, describing the look and the use of the related GUIs.
- Section 4 introduces the remote software—that is located in another place than the plant and the local software.
- Section 5 explains the functionalities and the GUIs of the remote connection. This is another part of the remote software, available for use from anywhere in the world with internet access.
- Section 6 presents the TCC Administration tool.

The EOLI Integrated System

The EOLI project is based on the idea that each WWTP is connected to a Remote Server Machine – located at a remote control centre - in order to upload measured data and alarms and download control actions. This Remote Server is essentially a supervisor system which implements a distributed control architecture. It has been chosen to use Internet as the main connection infrastructure between the Remote Server and each plant; this is because of the flexible, inexpensive and widespread nature of this medium.

The core, both at the remote control centre and at the local plant, is a database implemented in MySQL technology and it is used to store all the data gathered (measurements), generated (commands), transferred and managed by the EOLI system.
At the local plant level, the main frame software is organized in modules. Software modules can be enrolled into the system to implement features and functionalities.

The EOLI software architecture is based on the client/server technology in which different modules implemented for different purposes, can share the same resources using a relational database management system (DBMS) that is introduced to replace the limitations of the file sharing architecture: the client/server technology is a versatile, message-based and modular infrastructure that is intended to improve usability, flexibility, interoperability and scalability.
As far as the hardware architecture, in the EOLI project the approach addressed is the development of a WWTP digital platform designing an embedded electronic main board based on ARM technology and equipping each sensor and actuator with an embedded electronic slave board submitted to the main one.
In figure A a schema of the overall architecture of the EOLI system is represented. More details can be found in the deliverable D8.3.

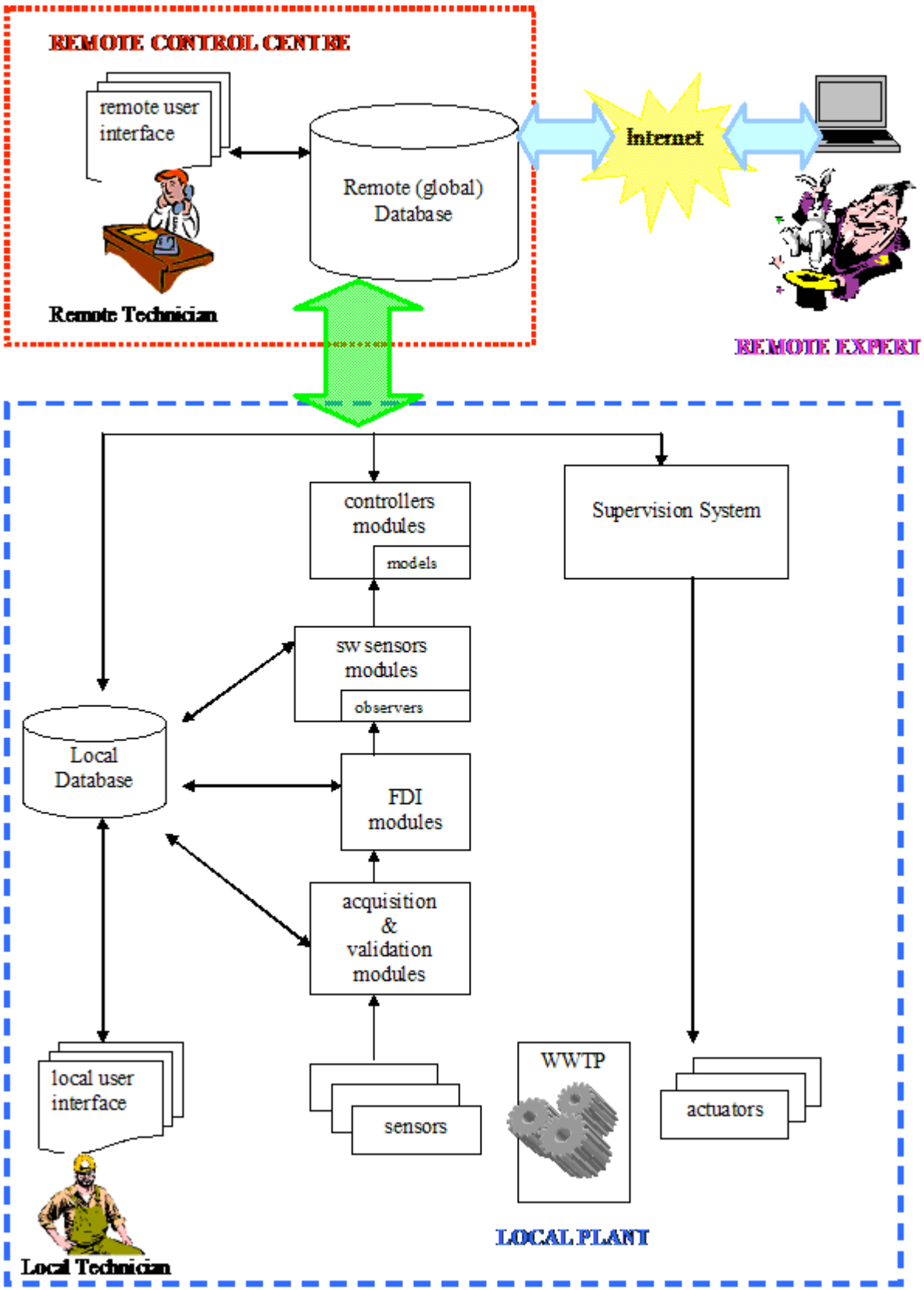

REMOTE CONTROL CENTRE
remote user interface
Remote (global) Database
Internet
Remote Technician
REMOTE EXPERT
controllers modules
models
Supervision System
sw sensors modules
observers
Local Database
FDI modules
acquisition & validation modules
local user interface
sensors
WWTP
actuators
LOCAL PLANT
Local Technician

Figure A

The integrated plants

This section presents a summary description of the two pilot plants, the full scale plant and the two lab plants that have been integrated with the EOLI system during the life of the project.

ENEA

The pilot plant is located sidestream to the Trebbo di Reno municipal WWTP and it is fed on real sewage drawn after grit removal.

The SBR (Figure B) is installed on a covered trolley; the monitoring and control unit is located in the near WWTP facility. The pilot SBR has a working volume of 500 L and is equipped with a mechanical mixer, a variable-flow blower connected to a membrane diffuser, two peristaltic pumps for influent loading and effluent discharge (flow rate = 6 L/min) and a pump for sludge wastage (flow rate 1 = L/min); the plant is also equipped with a multi-parameters converter for the on-line acquisition of pH, DO, ORP and temperature signals.

Each signal is recorded by a multi-function data acquisition card, installed on a PC. A software application has been developed in LabView 6.1 (National Instruments) to manage data acquisition. Actuators are controlled by a PLC interfaced to the acquisition card.

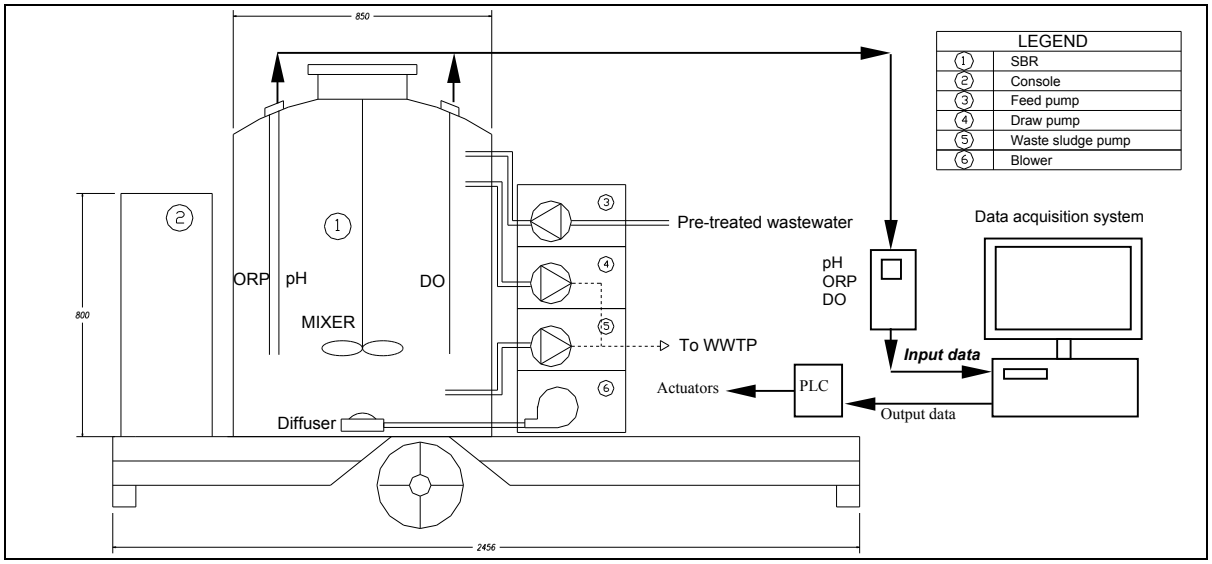


Figure B: plant layout of the ENEA-SBR.

Process description

The SBR is operated according to 4 cycles per day. Each cycle is described inFigure C. Each phase is described here below.

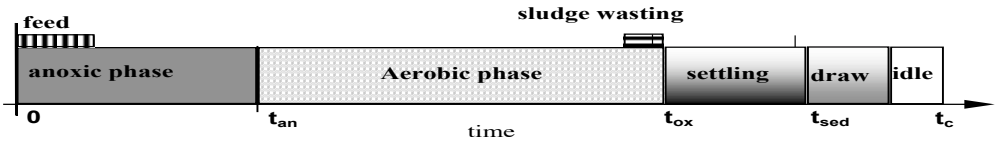


Figure C: SBR cycle

- *Fill phase:* 100 L of sewage are loaded in the SBR reactor. The loading pump is activated on a time-base, while level sensors control the pump stopping.
- *Anoxic phase:* only the mixer is working, its control is performed on a time-base.
- *Aerobic phase:* only the blower is working, its control is performed on a time-base. Sludge wastage takes place at the end of this phase, its control is performed on a time-base and the operator sets the phase parameters (pump flow rate and working time) to obtain the desired sludge age.
- *Settle:* The settling phase starts and the end of aerobic, its control is performed on a time-base.
- *Decant:* Effluent discharge starts at the end of settling phase, the peristaltic pump is activated on a time-base, while a level sensor control the pump stopping.

Influent quality varied with cycle to cycle. Influent characterisation during peak loads are reported inTable 1.

Table 1: Peak load influent characterization from October 12th to October 21st

Parameter	Concentration (mg/L)	Standard deviation	Determination method
COD_T	250-400	-	APHA, 1992
COD_S	200-350	-	APHA, 1992
pH	8.1	0.07	Potentiometric
TSS	135	0.02	APHA, 1992
VSS	30	0.01	APHA, 1992
$N\text{-}NH_4$	51.8	10.7	titration
$N\text{-}NH_4$	65.4	6.8	spectrophotometer APHA, 1992
TKN	69.8	4.5	APHA, 1992
BOD/COD	0.4-0.7	-	APHA, 1992

INRA

The SBR pilot reactor at LBE-INRA (Narbonne, France) has a total working volume of 200 L. It is equipped with various sensors in order to monitor the process and with the SPES platform that allows to manage the actuators and to store the data collected both in a local and in a remote database.
The SBR reactor is capable of operating both organic matter and nitrogen removal under aerobic and anoxic conditions.
More recently, in addition to the conventional sensors already implemented in the SBR reactor (pH, DO, redox potential, temperature, sludge level and influent volume/flow), two innovative sensors

developed within EOLI WP3 have been implemented and put into use: the UV sensor and the TITAAN (see EOLI deliverable D3.2).

The influent alimented to the reactor is prepared by the plant operators usually twice a week and it is stored in a separate reservoir, where it is kept in agitation at 4 °C to avoid its degradation outside the plant. As for its composition, the influent is made up of diluted milk serum, to witch is added a determined quantity of urea so to provide a sufficient amount of nitrogen to perform its removal. Micronutrients are also added to the feed in order to assure not limiting conditions for nitrifiers growth.
During the EOLI project experimental activities, the influent contained a charge of COD that was in the range 3-5 gCODtot/L and a charge of TKN in the range 200-300 mgTKNtot/L. The ratio COD/N can thus vary between 10 and 25 gCOD/N.

As for the sludge, the average total suspended solids (TSS) content is kept in the range between 4-6 gTSS/L, while the sludge retention time (SRT) is at least 20 days, to avoid an excessive withdrawal of the autotrophic biomass. The sludge management is operated manually.

As for the process, the pilot SBR operates a single cycle per day, with a variable number of feeding phases. At $t=t_0$ the volume of the reactor is 150 L, then a variable number of cycles fill-anoxic-aerobic are implemented; at $t=t_{END}$ the volume equals to 200 L. After $t=t_{END}$ there is a phase of sedimentation (settle), followed by a phase of effluent withdrawal, in order to restore the reactor at the initial conditions ($t=t_0$).
In particular, each cycle implemented between $t=t_0$ and $t=t_{END}$ is made up of an initial phase of alimentation, during witch a predetermined amount of influent is added (fill phase), then it follows a brief anoxic phase (30-60 minutes) and a larger period of aerobic conditions (3.5 – 9 hours). The ratio $time_{anoxic}/time_{aerobic}$ was varied in the range during the whole experimentation 0.11 to 0.14.
The air flow, during the aerobic phase, is 50 L/min and has also the purpose of mixing up the volume in the reactor: during the anoxic phase a pulse aeration guarantees the mixing.
A brief phase to evaluate automatically the coefficient of transfer between liquid and gas (K_La) has also been implemented in the sequence.

At the INRA the integration process involved:

- the hardware sensors developed within EOLI WP3;
- the supervision algorithms developed within EOLI WP7;
- the optimal control strategies developed within EOLI WP5.

With respect to WP2 a new simplified model structure for LBE SBR was proposed, evaluated and validated and some observers were evaluated within WP4. A series of laboratory analysis were performed on influent samples and on samples withdrawn from the reactor during the reaction phases. In addition to these off-line analysis, the conventional SBR instrumentation was used by the operators to follow the processes thanks to the expertise achieved with the daily work on the plant and the known correlation between process and signals (for instance the detection of the “ammonia valley” on the pH profile).
In particular we performed the following determinations:

- TSS, VSS, NO_2^-, NO_3^- for the validation of TITAAN and UV sensor (WP3);
- CODsol for the validation of the UV sensor (WP3);
- influent CODtot and TKNtot, TSS, VSS, NO_2^-, NO_3^-, KLa for:
  - the validation of the supervision algorithm for high load detection (WP7);
  - the validation of the controls CS2 and CS3 (WP5);
  - the model calibration and validation (WP2).

The Local Software

SPES Gateway is the name chosen for the local software and it is very useful to understand the role that it has inside the EOLI system: it is the **gateway** between the hardware components of the system (embedded electronic boards) and the high level software components running on the local PC. All the actions (acquisitions and actuations) scheduled by an operator or by a running software module, pass through it because of it constitutes the lowest level of communication with the plant, and also for this reason it is considered the LAYER0 for the software architecture.

The core of the local software architecture is a MySQL server database implemented at the local PC. More in general this LAYER0 is closely linked with the local MySQL database for the storing and the loading of the data: all the interactions between the SPES Gateway and the several software modules that implement the models, the software sensors, the controllers, the FDI and the supervision, pass through and are managed by this database server used as a media, in terms of data got or put from and into its tables.
The interaction with the process is implemented sending serial frames from the PC through the RS232 port to ask for data or to impose commands: these frames are received and parsed – according to a protocol - by an embedded system (ARM technology based) and immediately applied to the plant. The communication with the remote database is realized using XML text files sent to the remote server using Internet as media: a PHP parser that runs in the web server, extract the data from the XML files and store them in the tables of the remote database.

As far as this LAYER0, it has the role of the **Master** in the connection and communication flow with the process: actually the SPES Gateway requests the data to the plant filling the local database, according to a sample time chosen by the operator, and it applies the actions when they are scheduled into the same database.

The main tasks of the local software are:

1. Setting the acquisition sample time of the system.
2. Requesting the data according with the sample time chosen.
3. Giving a complete access for the hardware configuration.
4. Appling all the actions that are scheduled by software modules or human operators.
5. Sending the data to a remote database server in order to store them in the server machine.
6. Enrolling any executable modules in the system giving a full control on it.

7. Manage the local database maintenance automatically: the software erases the acquisitions older than a time chosen by the local operator (default value is 3 months).

The main window of the software is shown in *figure 1.1*.

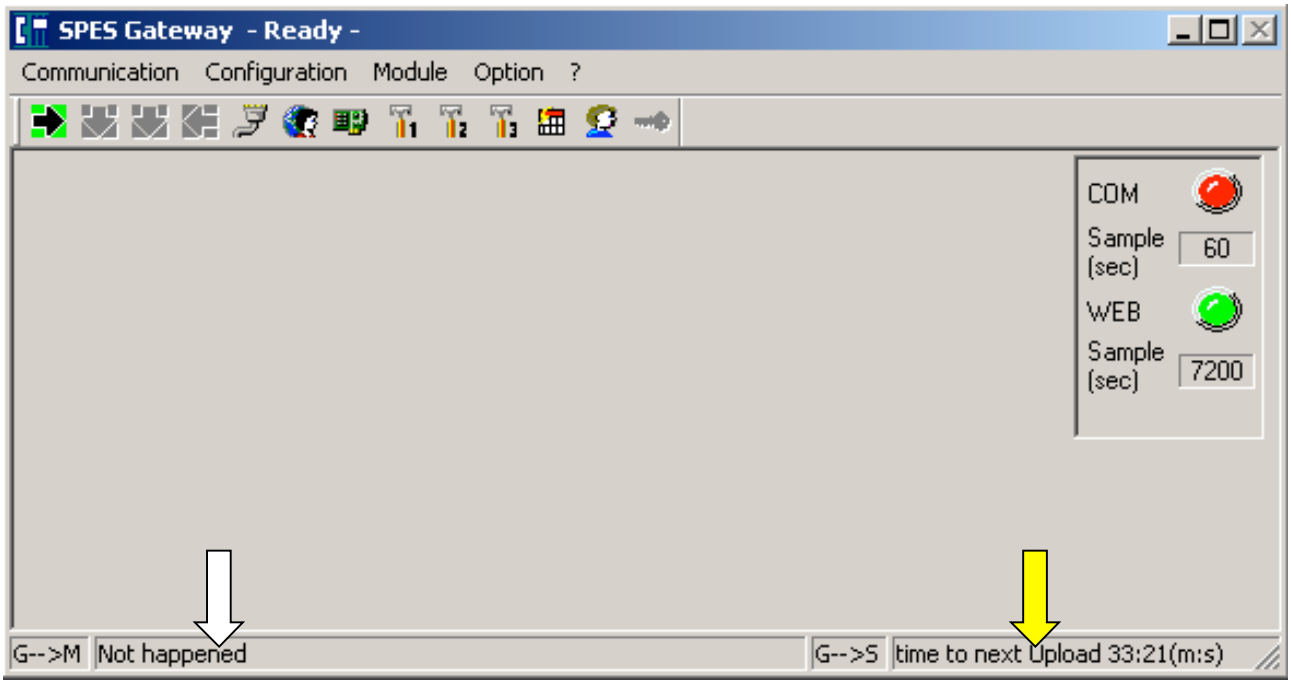


Figure 1.1 – SPES Gateway main interface

In the menu bar (*figure 1.2*) are contained all the operations that can be implemented in the software.

Figure 1.2 – menu

In the toolbar (*figure 1.3*) are presented the quickly references to the main functions.

Figure 1.2 – Tool bar

The status bar (*figure 1.4*) shows the actual status messages of the communication with the ARM based embedded board (G->M, white arrow in *figure 1.1*) and with the remote web server (G->S, yellow arrow in figure 1.1).

Figure 1.4 – status bar

In addiction the state of the communication is shown in a frame into the main window (*figure 1.5*) in which is reported the current sample time chosen for the acquisition and for the upload to the

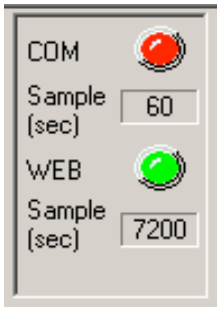


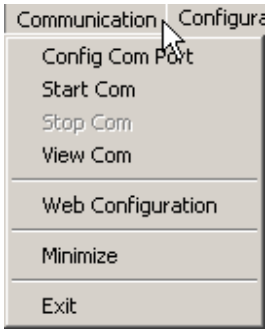
Figure 1.5

remote database, and their relative state (RED led means closed; GREEN led means opened and correctly operated).

The menu bar (*figure 1.6*) is composed by four sub-menu:

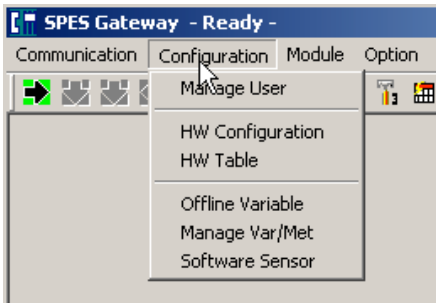
Figure 1.6 – menu bar

1. **Communication**: in this sub-menu We can set up the SPES Gateway communication interface. The *Config*, *Start* and *Stop Com* are used for the management of RS232 interface with the hardware embedded components. The *WebConfiguration* is used for the setup of the Web parameters. The *Minimize* option reduces the windows to the system tray while the *Exit* item ends the software itself (and represents the only way to close the LAYER0 because the cross button in the upper right side of the interface is disabled, to prevent unauthorized actions).

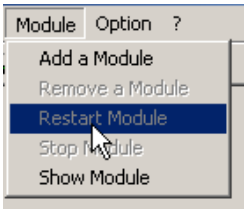


2. **Configuration**: in this sub-menu We can manage: the access' grants (*Manage User* Option); the configuration of the hardware embedded devices at the plant (*HW Configuration*); view

the current hardware configuration (*HW Table*); setup the variables measured at the plant with their methods (*Offline Variable, Manage Var/Met, Software Sensor*).



3. **Module**: in this sub-menu We can find all the functionalities for the configuration of the software modules to be enrolled and run into the system. We can add, remove, stop and restart any compiled software modules, and view the history of all the modules that are been managed by the SPES Gateway (*Show Module*).



4. **Option**: sub-menu with the possibility to save or load the configuration main tables of the plant (*Load/Restore Conf Option*); check the current indexes of all the tables of the database server (*View Index Table*); finally We can establish the number of days after that the acquired values will be erased from the local database in order to preserve the performance of the LAYER0 (*Maintenance Acquisitions*)..

As far as the local software SPES Gateway, an important point must be afford: the access to the functionalities of the software.

In fact, all the windows and panels can be opened only if the operator has an active account: the administrator of the SPES Gateway can allow and enable the use of the several features and functionalities of the system to other users that can enter with their username and password. If an

operator tries the access to a particular functionality of the software, a dialog window appears in order to enter his own access parameters (*figure 1.7*).

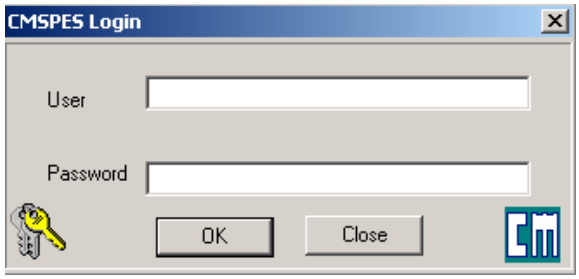


Figure 1.7 - login window

When the operator is correctly identified by the system, He can operate using the functionalities enabled for his account: after an idle time (ten minutes), the software will request the password again. Even the LAYER0 turning off can be accomplished only after a valid authentication.

When We are logged in, the icon of a yellow key appears in the toolbar; If We click the key We are immediately log out. If the icon is grey means that no user is logged in (*figure 1.8*).

Figure 1.8 - log out and log in

Communication Menu : Configure the COM RS232

For the setup of the COM parameters, We use the Config Com Port item inside the Communication sub-menu or We push the button indicated by the orange rectangle(*figure 2.0*) .

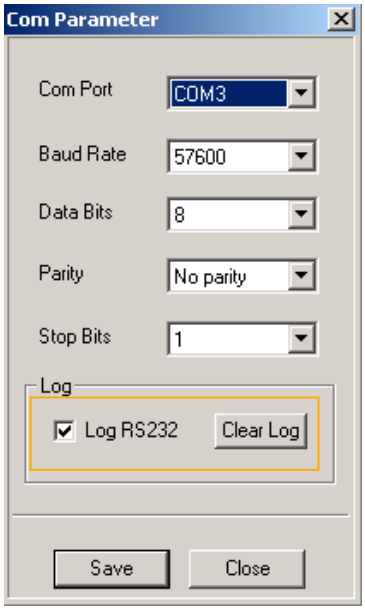
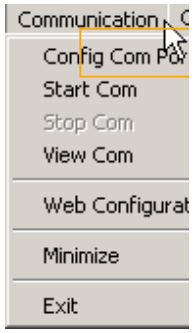


Figure 2.0



We can also establish if it must be done logs of the communication process (files .txt stored in the folder named *ComFile* located in the path of the executable of the software) or clear all the logs written since now.

When We push the Save button, the new parameters will be accepted and also a new *Comcfg.cfg* file in the CFG folder will be created with this data.

Communication Menu : Start/Stop COM RS232

To start the COM RS232 We must select the *Start Com* voice in the sub-menu (orange rectangle). Obviously to stop the Com, We must select the *Stop Com* option available only if the communication is turned on.

The color of the led in the status box change to green and the SPES Gateway starts the acquisition applying the sample time set by the operator.

In addition the window system tray icon of the software, changes its colour in green. To check the packets that are exchanged between the ARM based main board and the SPES Gateway, We can open the *View Com Panel* (Blue Rectangle) in which are reported all the frames exchanged under their hexadecimal format with the relative date and time (*figure 2.1*).

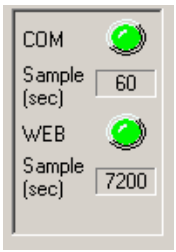
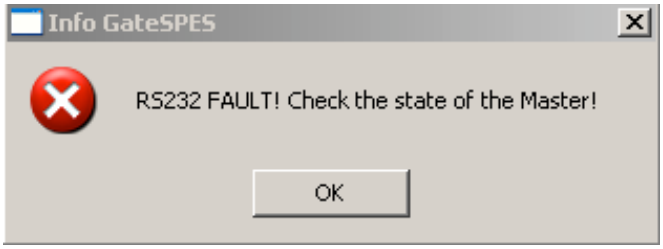


Figure 2.1 - view RS232 hexadecimal packets

If there is some problems in the communication process, the window system tray icon change the

colour in red and after a fixed number of attempts to recover the communication failed, an error dialog appear to warning about this fault. The only way to try recovering the serial communication is to reopen the com RS232.



Either at the power on or at the reset of the whole system, or at least of the hardware embedded components, few minutes are needed for the start up of the system before it is able to properly manage the serial link.

So it is suggested to wait some minutes after the power on or the reset of the system before opening the serial connection.

Communication Menu:Web Configuration

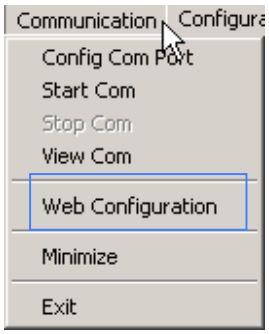
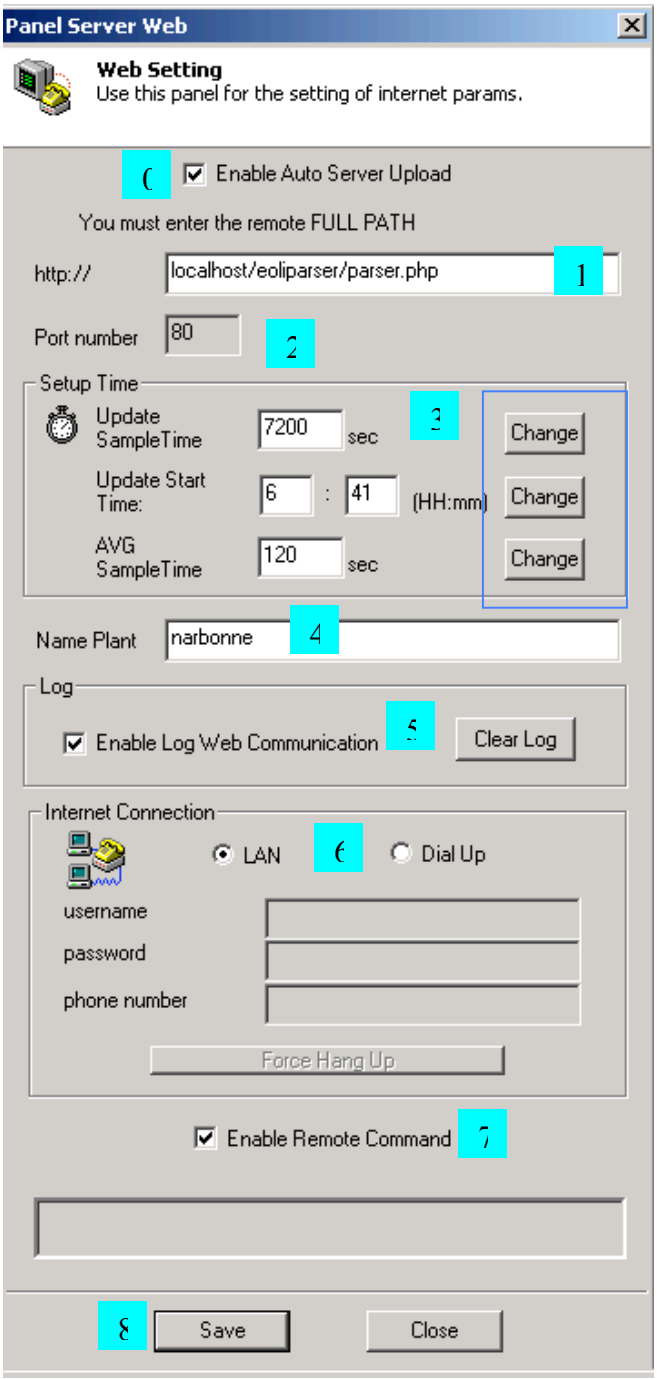


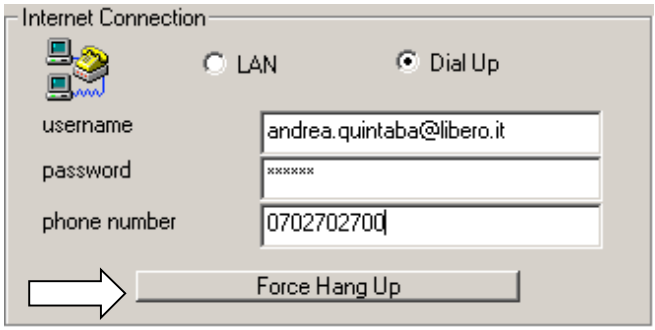
Figure 2.2 web interface

The panel must be used to set the configuration of the data upload to the remote web server. First of all We must enable the function by a click on the check box named *Enable Auto Server Upload*(0).



The main parameters are:

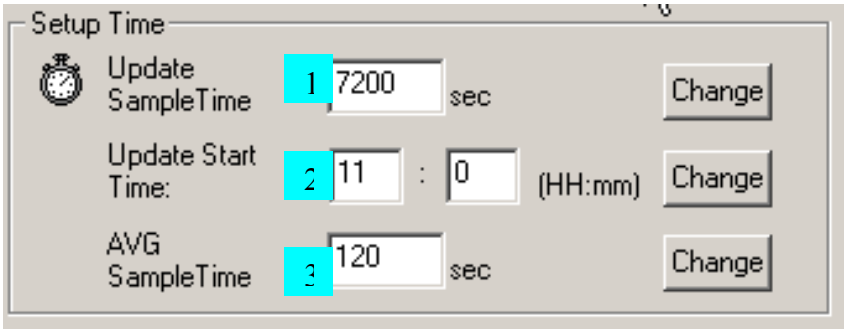
1. **Remote FULL PATH**: this is the internet address of the script file that parse the XML file sent by SPES Gateway in order to recover the data and insert them in the MySQL remote database server tables.
2. **Port Number**: the remote port number is fixed and We cannot chose it.
3. **Setup Time**: in this section We must input the start date for the upload, the sample time for this upload (Update SampleTime) and the sample time for the average measurement computation (AVG SampleTime). Actually not all the data from the local database are transferred to the remote database, but a time based average. This to optimise the remote transfer of data in terms of time and speed, in spite of the characteristics and performances of the PC used at the plant.
4. **Name Plant**: this is the identification name of the process inside the EOLI system. This parameter is very important and must correctly match the name stored and used in the remote database.
5. **Log**: We can choose if the software must generate txt files with the data sent to the remote system (files with an XML format) to be used for test and debug.
6. **Internet Connection**: the type of connection used by the local PC. In the case of the Dial Up connection, We must enter also the parameters for the dial connection.



The Force Hang – Up is used to close immediately all internet outgoing connections (white arrow).

7. **Enable Remote Command**: this checkbox must be selected if We want that remote commands stored into the remote database can be applied to the plant.
8. **SAVE button:** in order to apply our choices, We must push the save button. It is important to notice that the system will start to send data to the remote server from this time forward: for example, if We activate local software for the acquisition at twelve o clock and set the web parameters only one hour later, the data acquired till there into the local database will be lost for the remote database because of they will not be uploaded to the remote web server. The save button must be considered as a reset of the internet communication. Instead, to change the sample time without restart all the inside counters, we can click the change button (blue rectangle in the panel).

Important to consider is the Setup Time frame.



1. The Update SampleTime is the sample time for the Upload.
2. The Update Start Time is the starting time for the upload. During the normal operation the local software registers the time of the last upload, so this parameter must be set only to reset the internal counters.

Example:

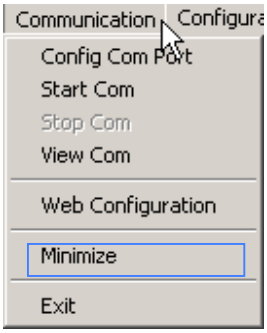
We choose an Update Start Time equal to 11:00 and an Update SampleTime equal to 7200 seconds (2 hours). Well, at 11:00 o clock the local software will send to the remote server the XMLUpload and after it will evaluate the time for the next uploading (that is the 11:00 + 2 hours = 13:00). In this way, if the SPES Gateway will be stopped, It anyway will be able to schedule the time for the upload operation.

In the status bar of the SPES Gateway it is always displayed the time remaining for the next upload (m:s), so that it is always possible to check if the system is working well.

3. The AVG time is the time period for the measurement average evaluation, and it's used to decrease the number of data to send the remote database server without losing information about the measurement itself: the system, in addiction to the normal acquisitions, execute the calculation of the average values, and saves them with the method **avgonline**. When it's time to do a new upload, these averages will be sent to the remote database system as data value.

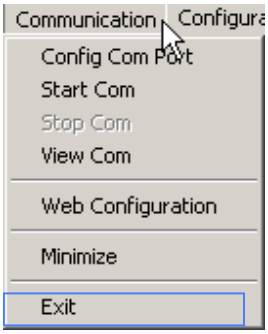
In order to apply new values without resetting the whole Web configuration, We can push simply the Change button concerning with the parameter that We want change.

Communication Menu : Minimize



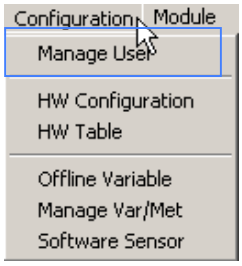
The *Minimize* item is useful to hide the SPES Gateway main windows from the pc desktop: it can be opened again by the menu that appears if We click the right button of the mouse over the software icon in the window system tray.

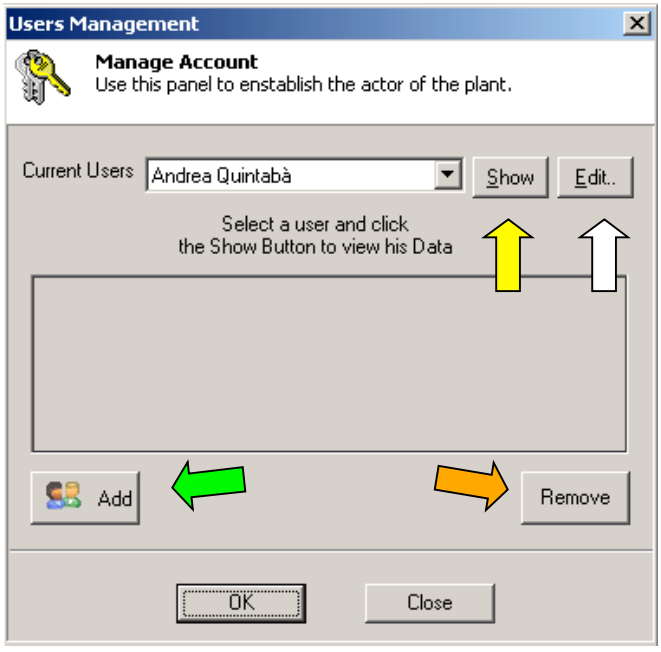
Communication Menu : Exit



The *Exit* item forces the SPES Gateway to close the communication with the master ARM based board and the server web, to close all active threads and to free all hold memory. This is the only way to close the software, as the default cross button of the main window is disabled. Anyway it is a good practise to close first the COM RS232 and after the software to prevent possible not correct shutdown procedure.

Configuration Menu: Manage User





The *Manage User* panel is accessible only by the administrator. The panel shows a list of all the current enabled users and by clicking the Show button (yellow arrow) We can view their main data (name, mail, phone, etc).

To modify an existent user We can click the Edit button (white arrow). If We want remove a current user We must choose its name from the list of all users and click the remove button (orange arrow): a confirm panel will appear in order to check our choice.

Finally, adding a new user is possible through a click on the Add button (green arrow). The Add User and the Edit panels are shown in *figure 3.1*.

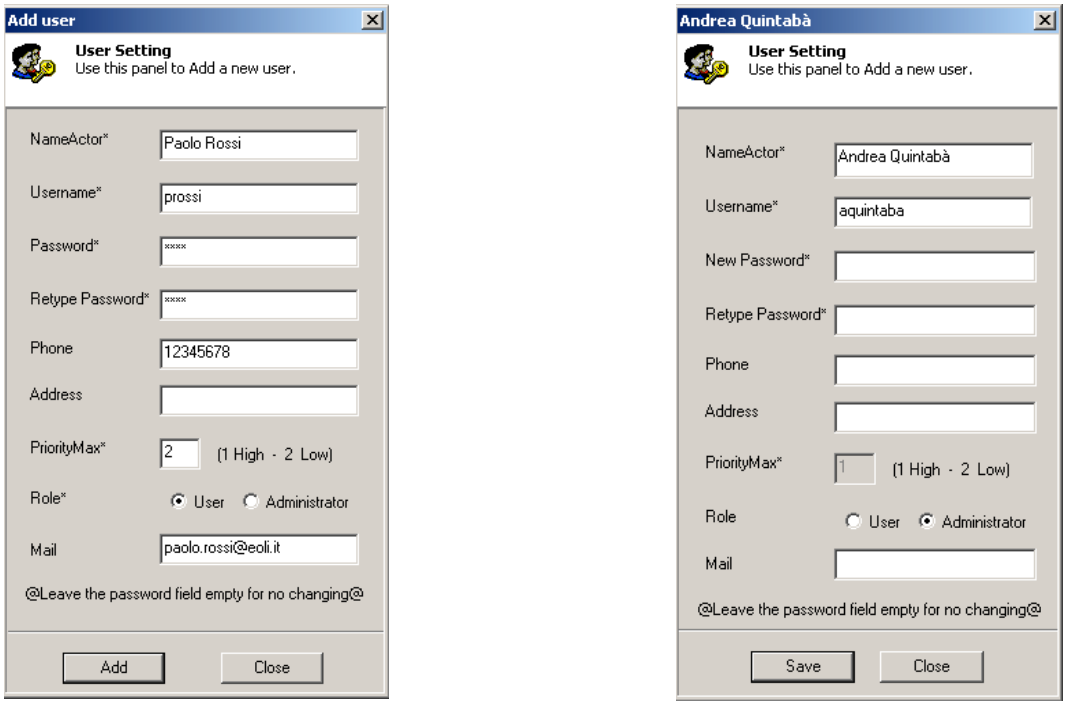


Figure 3.1 add and edit user panel

Particular care has to be taken concerning with the different grants to access the local software. As We can see in *figure 3.2*, the

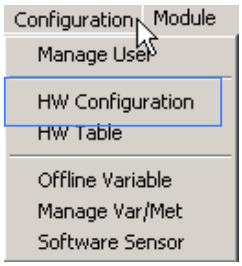
figure 3.2 – different user access

possible roles are **administrator** and **user**.

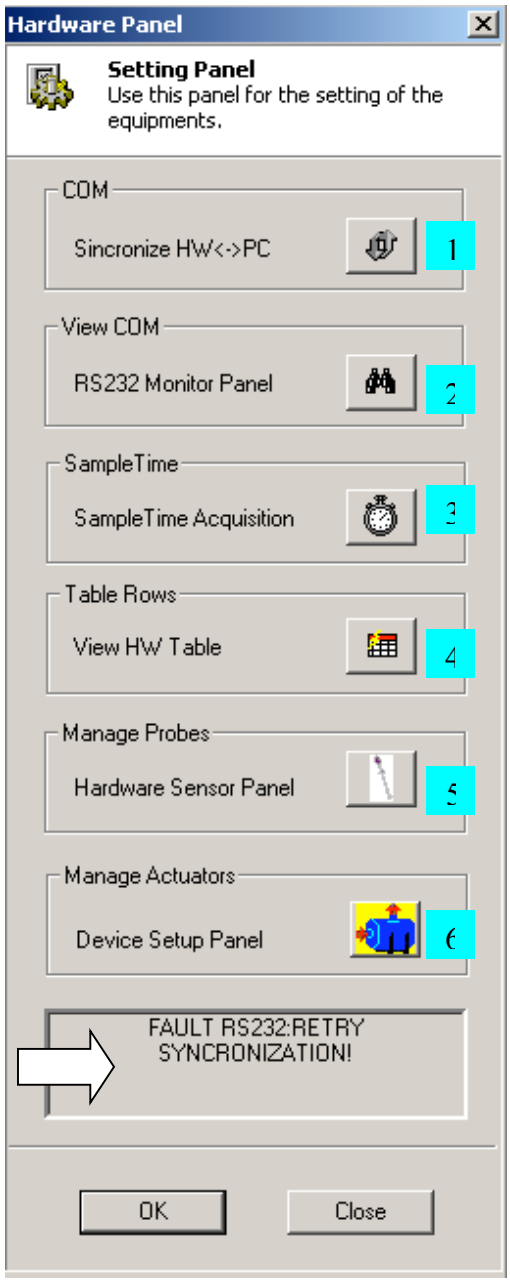
- The **administrator** is the highest level of access and He can do every actions He wants.
- The **user** represent the standard access mode to the software. If it has a priorityMax equal to 1, it enables a full access to the system with the exception of the user management panel (administrator's exclusive right); a priorityMax 2 (or higher in future releases) means that the user is not allowed for full access but only for the use of those particular software modules enabled on the basis of the priority value.

Configuration Menu: HW Configuration

This panel is used for the configuration of the hardware devices (probes, sensors and actuators) at the plant.



When the panel is opened, the RS232 com port is activated in order to recover the actual configuration of the plant: this configuration is stored into the non volatile memory of the ARM based main board and it must be cloned in a table of the MySQL local database server, in order to match the plant as a snapshot. This action is the Synchronisation HW<->PC. This is very important in order to increase the modularity and customisability of the EOLI system: the SPES Gateway can be used at any plant without particular problem and in spite of the number and type of sensors and actuators: the only thing to take care is that the hardware table match exactly the configuration of the plant, but this can be done and checked very quickly using this tool.



After the synchronization and only if the procedure has had success, We can use all the functionalities of the panel that can be summarized as below:

1. *Synchronize HW<->PC*: perform the operation described above.
2. *RS232 Monitor Panel*: We can open the dialog window that traces the communication between PC and the ARM based main board (*figure 2.1*).
3. *SampleTime*: We open the panel that sets the acquisition sample time of the system.
4. *View HW Table*: We open a window that displays the current Hardware Table (*figure 4.2*).
5. *Manage probes*: We can set the configuration for the probes of the plant.
6. *Manage Actuators*: We can set the configuration for the actuators of the plant.

When We open the HW Configuration panel, if the acquisition was activate, it is automatically stopped: in fact this two operations cannot be done at the same time. The white arrow above, show the message frame for the actions done and for the status of the communication with the main board.

HW Configuration: SampleTime Acquisition

The panel is shown in *figure 4.1*.

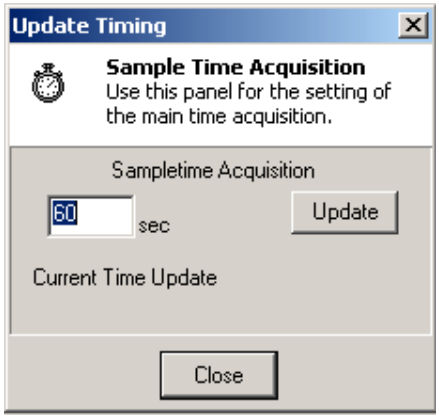


Figure 4.1

The control in the panel shows the sample time in use (the default value is 60 seconds) and We can change it: the only bond is the minimum value that cannot be under 30 seconds. Clicking the Update button, the new time is registered and a command with the new value is sent to the main board, in order to change this parameter.

HW Configuration: Table Rows

This panel is used to have a snapshot of the hardware configuration of the plant (*figure 4.2*).

hwequipment

row_num	description	address	type	value	valASCII	k	idVariable	varType	Status
0	NULL	00000A0000000000	0	0000000000000000	0	1.0000	NULL	1	empty
1	Water Temperature	030102000D000000	3	0000000000000000	0.0000	1.0000	S0	0	active
2	pH	030101000D000000	3	0000000000000000	0.0000	1.0000	S1	0	active
3	REDOX	030104010D000000	3	0000000000000000	1234566	1.0000	S2	0	active
4	DO Gas	030105000D000000	3	0000000000000000	0.0000	1.0000	S3	0	active
5	DO Liquid	030105010D000000	3	0000000000000000	0.0000	1.0000	S4	0	active
6	Sludge Level	030103020D000000	3	0000000000000000	0.0000	1.0000	S5	0	active
7	CO2	030103030D000000	3	0000000000000000	0.0000	1.0000	S6	0	active
8	Air Flow Meter	030103010D000000	3	0000000000000000	0.0000	1.0000	S7	0	active
9	Influent Flow Meter	030103000D000000	3	0000000000000000	0.0000	1.0000	S8	0	active
10	Influent Volume	030206030D000000	1	0000000000000000	0	1.0000	S9	0	active
11	TITAAN Influent Feeding CMD	030206000D000000	1	0000000000000000	0	1.0000	S10	0	active
12	TITAAN Sludge Feeding CMD	030206070D000000	1	0000000000000000	0	1.0000	S11	0	active
13	Influent Feeding Pump Switch	030207000A000000	1	0000000000000000	0	1.0000	S12	1	active
14	Influent Feeding Pump Control	030208000A000000	1	0000000000000000	0	1.0000	S13	1	active
15	Influent Cleaning pump	030207010A000000	1	00000000FFFFFFFF	1	1.0000	S14	1	active
16	WithDraw Valve	030207020A000000	1	0000000000000000	0	1.0000	S15	1	active
17	Sludge Feeding Pump	030207030A000000	1	0000000000000000	0	1.0000	S16	1	active
18	Sludge Cleaning Pump	030207050A000000	1	0000000000000000	0	1.0000	S17	1	active
19	Influent Valve	030207060A000000	1	0000000000000000	0	1.0000	S18	1	active
20	Air Flow Valve1	030307000A000000	1	00000000FFFFFFFF	1	1.0000	S19	1	active
21	Air Flow Valve2	030207040A000000	1	0000000000000000	0	1.0000	S20	1	active
22	Air Flow Control	030308000A000000	1	0000000000000000	0	1.0000	S21	1	active

Figure 4.2 – hardware configuration of the system

HW Configuration : Manage Probes

Each device or equipment installed at the plant, probes, sensors and actuators, is managed by the EOLI system in terms of the channel at which it is connected, characterised by a set of configuration parameters.

We can edit the parameters of a device that is enrolled in the plant or We can add a new device using one of the channels still available. To add a new probe or sensor

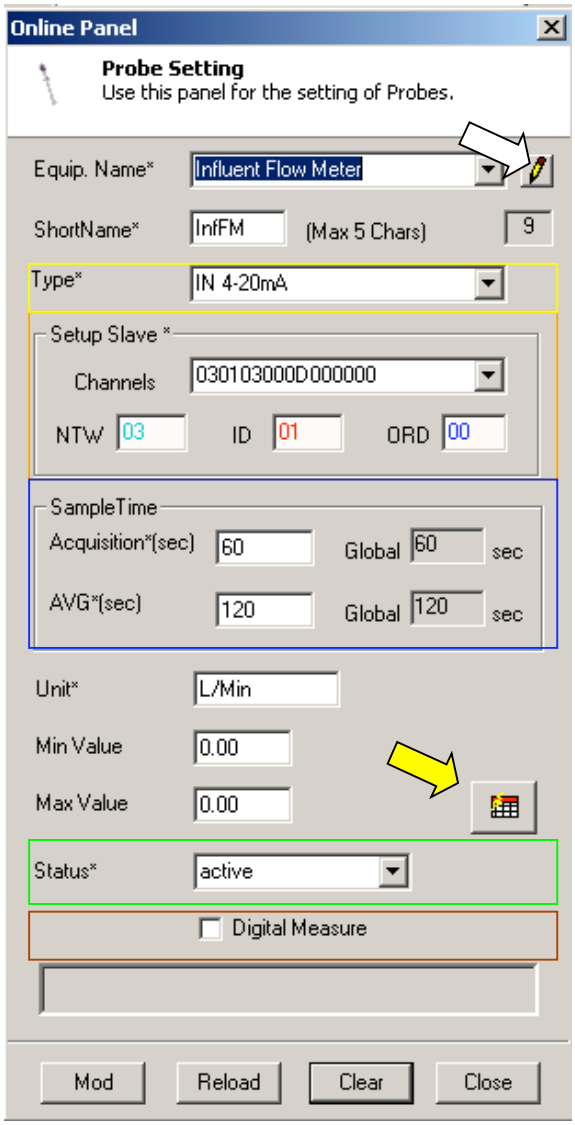
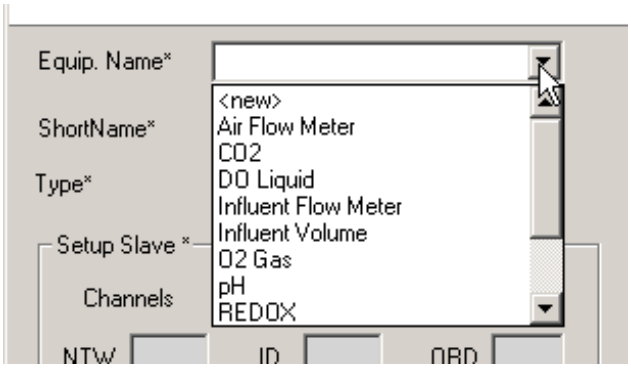


Figure 4.3



when We select the type (yellow rectangle), the channels still available are shown in the *Setup Slave* frame (orange rectangle).

In addiction, We can also set the acquisition sample time and the average sample time for each device (blue rectangle).

The parameter labelled as *Digital Measure* (brown rectangle) must be managed with care: actually if We check for this option, the equipment will be considered as a digital device, and this means that only the change of its value will be upload to the remote server. The average value isn't computed for the digital data.

Example:

The current value for the digital equipment is 100 and the local software sent it to the web server. After a sample time, We image that the new value is still 100: in the local database, this data will be inserted, but it will not send the remote server because it is not changed.

Another important parameter is the status (green rectangle) of the equipment that can be:

1. ACTIVE: the device is turn on.
2. DEACTIVE: the device is at the moment turn off (the cause for this may be a maintenance, for example).

When the status of equipment is set to DEACTIVE, the local software will not request for the measurement acquisition from it.

Note: if We want change only the name of the device, We can use the pencil button (white arrow in *figure 4.3*) and edit the new name for the equipment (*figure 4.4*).

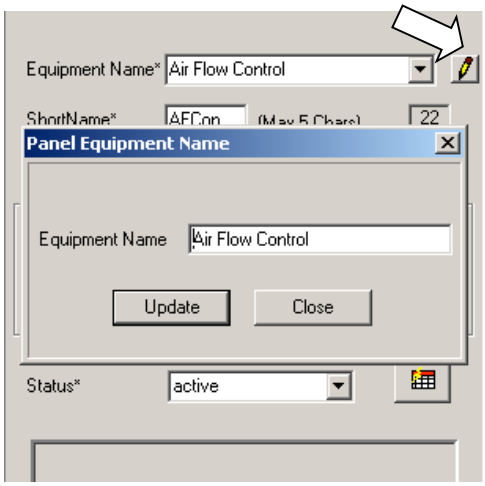


Figure 4.4 – Change the name of equipment

The panel provides a frame that shows messages about the result of our actions (*figure 4.5*).

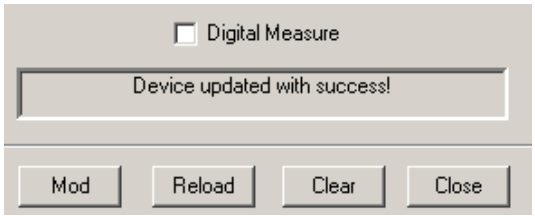


Figure 4.5 - message frame

The changes applied to the hardware equipment configuration are transferred to the ARM based main board through the RS232 serial link in order to have always the hardware tables synchronized.

The table button (yellow arrow in *figure 4.3*) shows the actual configuration of the bioprocess (*figure 4.4*).

bioprocessinfo

id	idVariable	idType	unit	min	max	sampleTime	AVGTime	digital	nameEquipment	shortName
1	S0	V2	°C	0.0000	100.0000	60	120	0	Water Temperature	T
2	S1	V1	upH	1.0000	14.0000	60	120	0	pH	pH
3	S2	V4	mV	0.0000	0.0000	60	120	0	REDOX	REDOX
4	S3	V5	%	0.0000	0.0000	60	120	0	O2 Gas	O2
5	S4	V5	mg/L	0.0000	0.0000	60	120	0	DO Liquid	DO
6	S5	V3	cm	0.0000	0.0000	60	120	0	Sludge Level	SL
7	S6	V3	%	0.0000	0.0000	60	120	0	CO2	pCO2
8	S7	V3	L/Min	0.0000	0.0000	60	120	0	Air Flow Meter	AirFM
9	S8	V3	L/Min	0.0000	0.0000	60	120	0	Influent Flow Meter	InfFM
10	S9	V6	L	0.0000	0.0000	60	120	1	Influent Volume	InfVo
11	S10	V6	empty	0.0000	0.0000	60	120	1	TITAAN Influent Feeding CMD	TInfF
12	S11	V6	empty	0.0000	0.0000	60	120	1	TITAAN Sludge Feeding CMD	TSluF
13	S12	V7	NULL	0.0000	0.0000	0	0	0	Influent Feeding Pump Switch	IFPS
14	S13	V8	NULL	0.0000	0.0000	0	0	0	Influent Feeding Pump Control	IFPC
15	S14	V7	NULL	0.0000	0.0000	0	0	0	Influent Cleaning pump	InCP
16	S15	V7	NULL	0.0000	0.0000	0	0	0	WithDraw Valve	WDVal
17	S16	V7	NULL	0.0000	0.0000	0	0	0	Sludge Feeding Pump	SFP
18	S17	V7	NULL	0.0000	0.0000	0	0	0	Sludge Cleaning Pump	SCP
19	S18	V7	NULL	0.0000	0.0000	0	0	0	Influent Valve	InfVa
20	S19	V7	NULL	0.0000	0.0000	0	0	0	Air Flow Valve1	AFVa1
21	S20	V7	NULL	0.0000	0.0000	0	0	0	Air Flow Valve2	AFVa2
22	S21	V8	NULL	0.0000	0.0000	0	0	0	Air Flow Control	AFCon
23	S22	V23	empty	0.0000	0.0000	0	0	0	Phase	Phase
25	S23	V15	mg/l	0.0000	10000.0000	0	0	0	COD	COD
30	S24	V17	mg/l	0.0000	0.0000	0	0	0	NO2	NO2
31	S25	V18	mg/l	0.0000	0.0000	0	0	0	NO3	NO3

Figure 4.4 – bioprocess configuration

HW Configuration: Manage Actuators

This panel is used for the configuration of the actuators at the plant (*figure 5.1*).

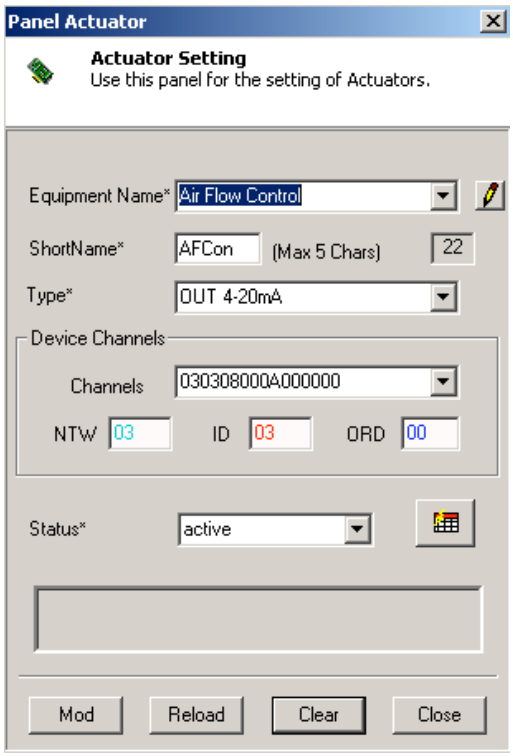


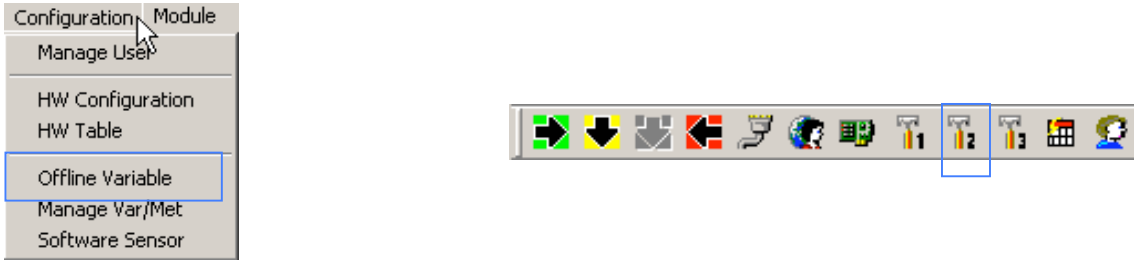
Figure 5.1 – actuators panel

The structure of the dialog window is similar to the probes' one: We can add a new actuator or edit an old one in the same way.

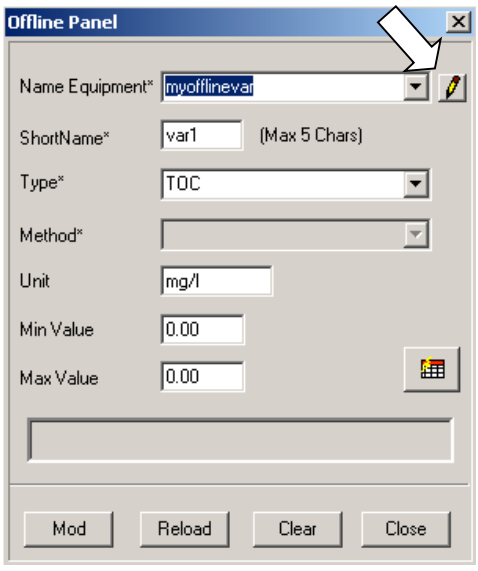
Configuration Menu: Hardware Table

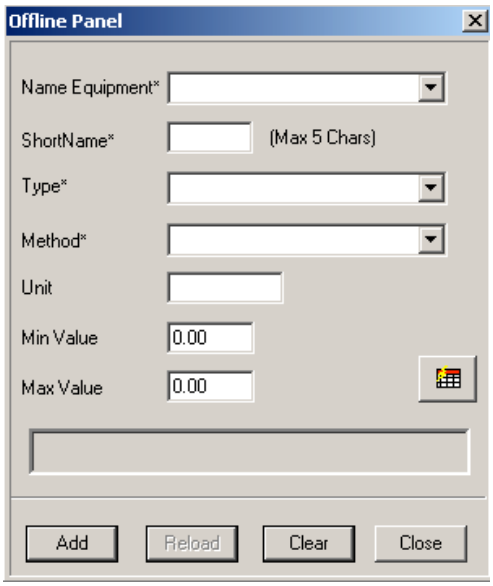
This menu item shows the hardware configuration of the plant (*figure 4.2*). There is also a shortcut in the software toolbar (red table icon).

Configuration Menu: Offline Variable



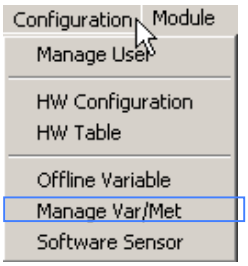
This dialog window is used to manage the measurements acquired offline at the plant. The interface is the same as the online panel: in this case the steps to do are less, because We don't have to select any channel to be connected with an hardware equipment or device.

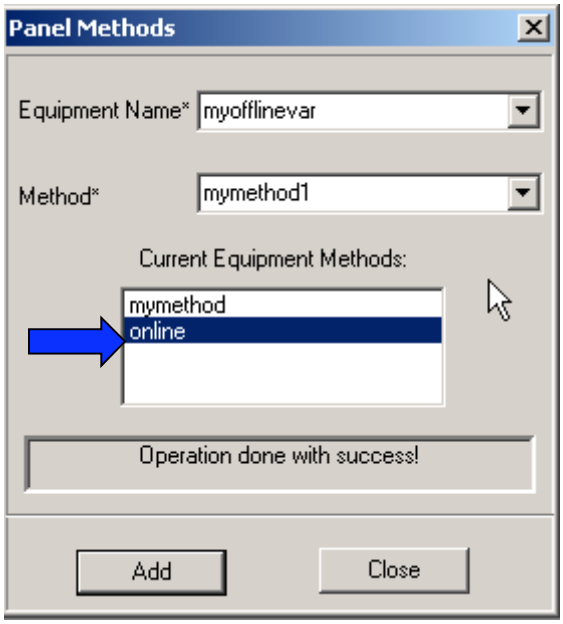




If We select an equipment already enrolled, We can change its parameters and for edit the name equipment, We use the pencil button (white arrow).

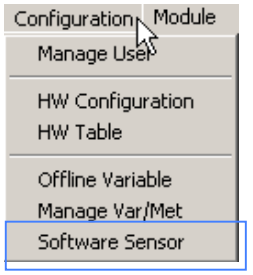
Configuration Menu: Manage Var/Met

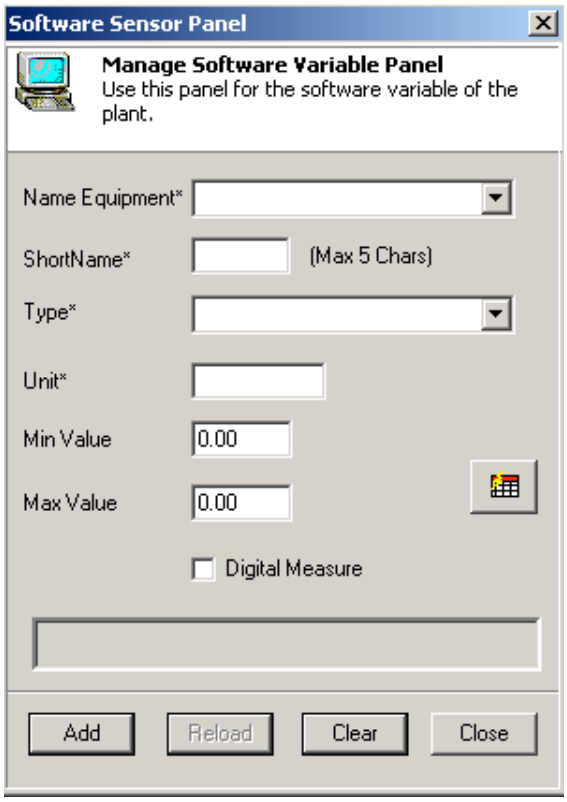




This panel is used for the management of the measurements methods for all the variables acquired. The dialog window shows the current methods used to acquire each measurement (blue arrow) and We can add new methods after we selected the equipment in the panel.

Configuration Menu: Software Sensor

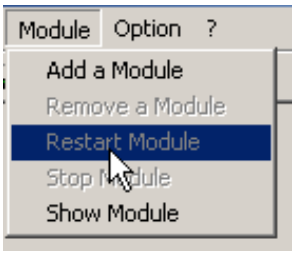




This panel must be used to enrol those variables that will be acquired online but not by an hardware devise or equipment linked to the system. These kinds of measurements are generated by software modules that work to compute particular estimations.

The structure of the dialog window is similar to the previous panel.

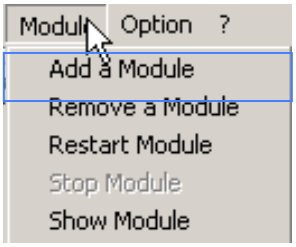
Module Menu



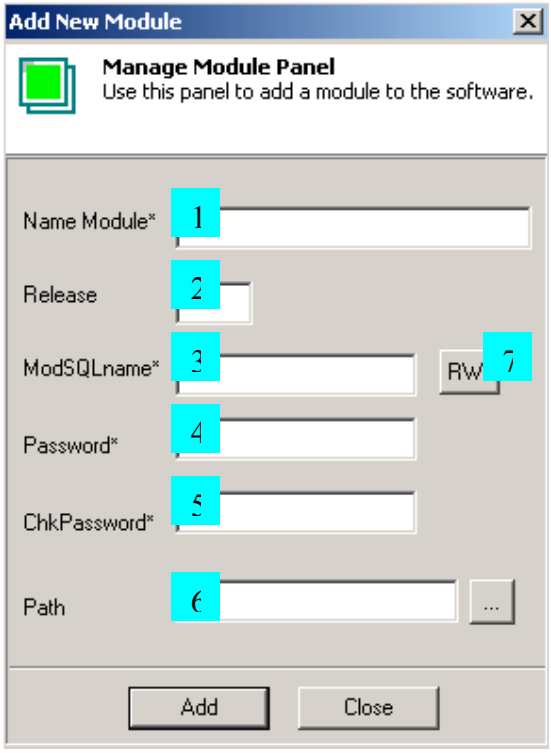
This menu contains all the options for the management of the software modules that run interacting with the plant through the SPES Gateway. We can implement four main actions:

1. Add a Module: use this option to enrol a new software module in the SPES Gateway.
2. Remove a Module: use this option to remove a module running under the system.
3. Restart a Module: use this option the start a module that was previously stopped by an operator.
4. Stop a Module: use this option to stop a running software module.
5. Show a Module: use this option to show the history of the modules enrolled in the system.

Module Menu : Add Module



The parameters that We must enter in order to add a new compiled software modules into the EOLI system are:



1. *Name of the module*: label that will be used to identify this module.
2. *Release*: release number of the software module.
3. *ModSQLname*: MySQL account that We want assign to the software module.
4. *Password*: the MySQl password We want assign to the software module.
5. *ChkPassword*; control to check the password.
6. *Path*: the complete path to the executable file of the software module We want to enrol in the system.

7. *RW*: the MySQL privileges that the module will have for its access to the local database. The window dialog of the Mysql Grant is shown in figure 5.2.

To select the correct path We click on the ... button in order to open the Dialog Window shown in *figure 5.1*.

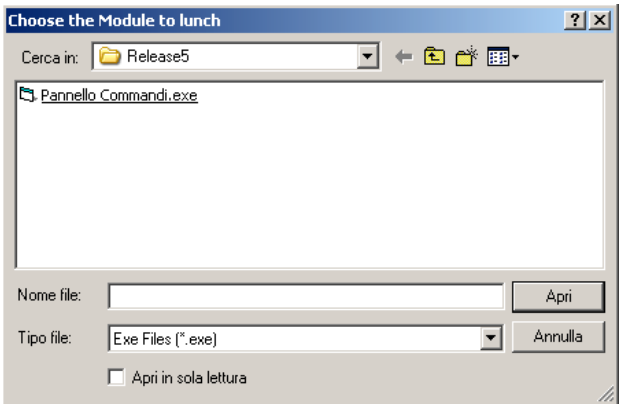


Figure 5.1 – path to the executable of the module

The Grant Panel shows all the tables of the database and for each one We can select between three options:

- READ: The module can read the table (query of type SELECT).
- WRITE: The module can read and write table(query of type INSERT,UPDATE,SELECT).
- EMPTY: The module hasn't grant for this table.

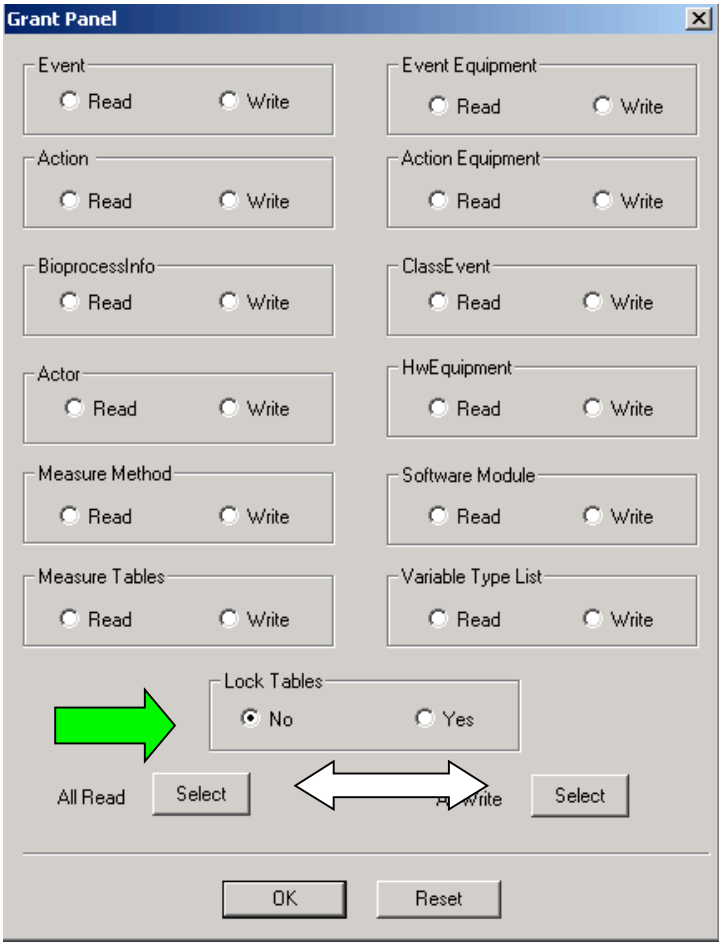


Figure 5.2

The *Lock Tables* option (green arrow) establishes if the module can lock a table in reading or writing, useful for the integrity of the data stored in the database server.

We can assign quickly all the read or write grants by a click on the corresponding button (white arrow).

After that We have successfully add the software module to the system, the SPES Gateway launches the executable file and add a new status led to the main window that shows the current status of that module (white arrow in *figure 5.3*).

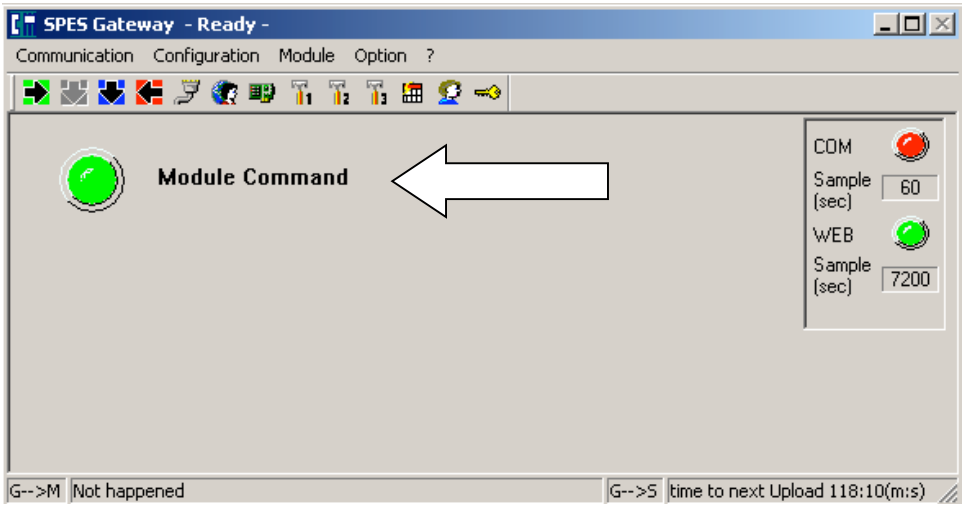


Figure 5.3 – main interface with a module enrolled

The SPES Gateway tracks every second the state (turn on or off) of all the software modules that it has enrolled and change the status led to red if a module is stopped by the operator (white arrow in *figure 5.4*).

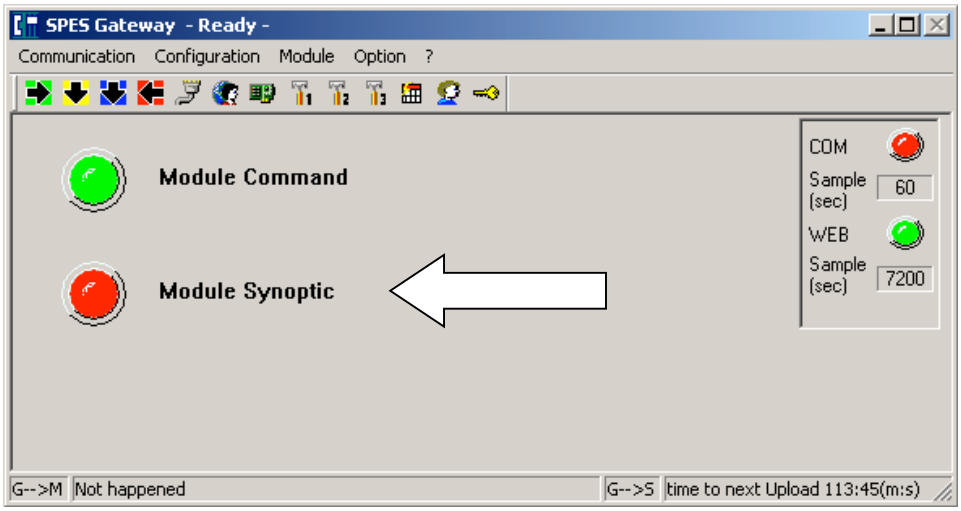
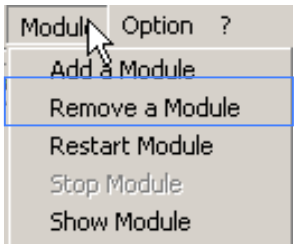
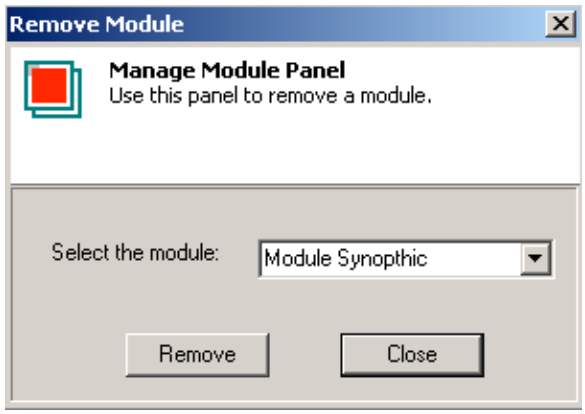


Figure 5.4 - main interface with modules enrolled

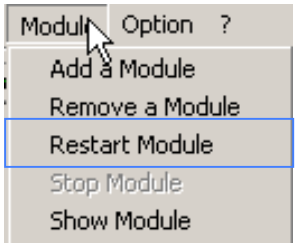
Module Menu: Remove Module



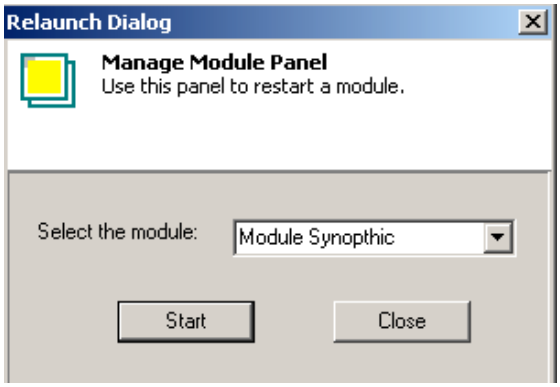


This Option must be used to remove a software module from the system. The access to this panel and to the others is restricted only to the operators with correct rights. When We remove a software module, also its led on the main windows will be removed.

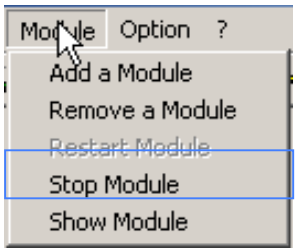
Module Menu: Restart Module



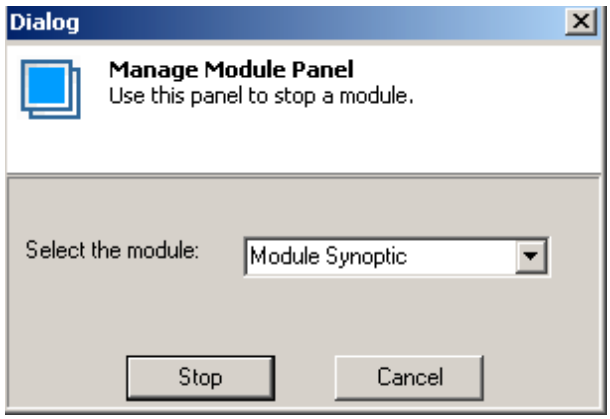
This option must be used to run a software module previously stopped. The option will be able only if there is a software module to restart.



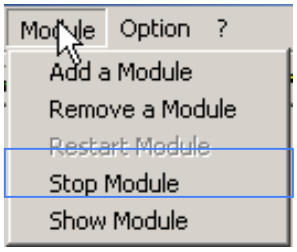
Module Menu: Stop a Module



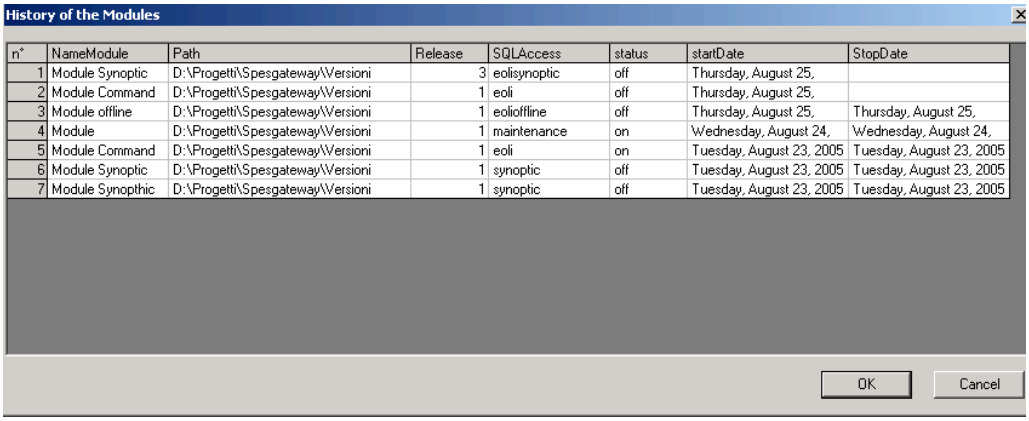
This dialog window must be use to stop the running of a selected software module.



Module Menu: Show Module



The panel shows all the modules that are been enrolled in the system since now.

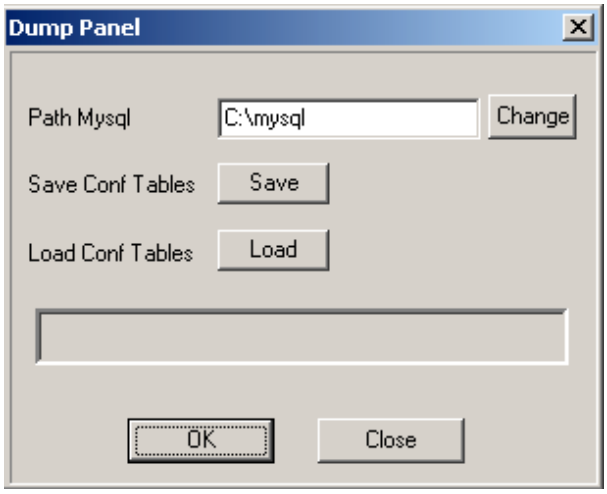


When the SPES Gateway is closed, also all the enrolled modules that run at that moment will be stopped. In the same way, when the SPES Gateway is restarted all the modules that have the state on will be launched.

Option Menu

This menu contains some utilities to restore o check the software configuration.

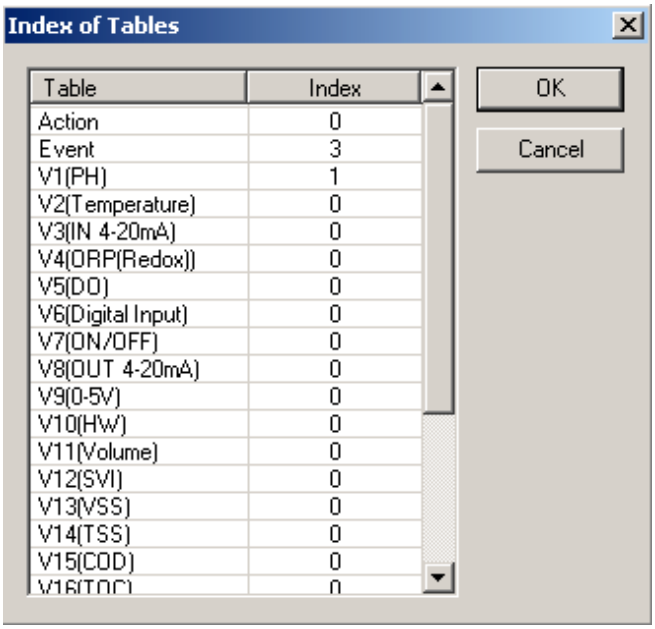
Option Menu: Load/Restore Conf



With this panel We can save the actual configuration tables of the plant in order to recover them in the case of a corruption of the local database server.

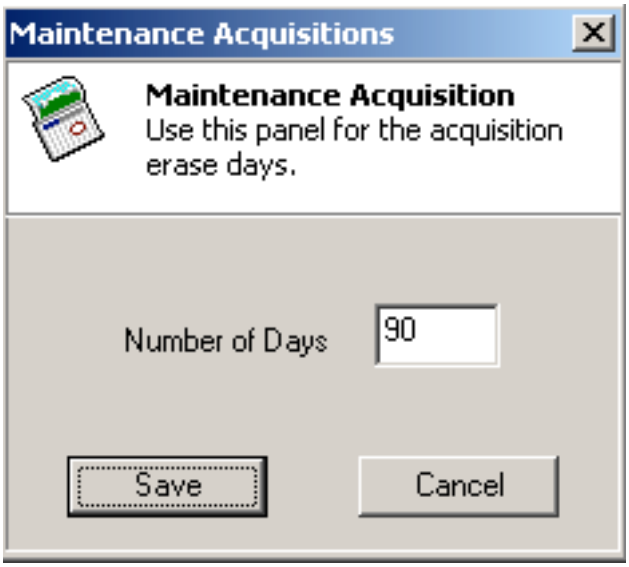
The file *CMTable_conf.cm* with the SQL instructions and queries is stored in the windows folder of the machine.

Option Menu: View Index table



The panel shows the last indexes of the records in the database tables sent the remote database server with the XML upload file. This information may be useful to check the right operation of the local software.

Option Menu: Maintenance Acquisitions



The panel must be used to setup the number of days over that the software will begin to erase the acquired values..

Example:

We have chosen a number of days equal to 90.

For instance: today is the 20th of September. Every day at 2:00 o' clock a.m., the software erases all the measurements which are older than 90 days from today, that is from the 19th of June backwards. Therefore in the database, We have always the last three months of measurements, without a loss of software performances.. Of course, this time window can be set to be compliant with the PC resources.

The Remote Software

The EOLI remote interface is available only if the user is provided with an Internet Browser such as Microsoft Internet Explorer , Mozilla, Netscape, Firefox and obviously with an internet connection. These only are the tools necessary for the connection to the remote interface.

First of all, after We opened our favourite browser, We fill the address bar with the URL of the EOLI server as It's shown in *figure 1* and then We push the go button:

figure 1 : url bar in Microsoft Internet Explorer

The first page of the EOLI server is the login page in *figure 2* :

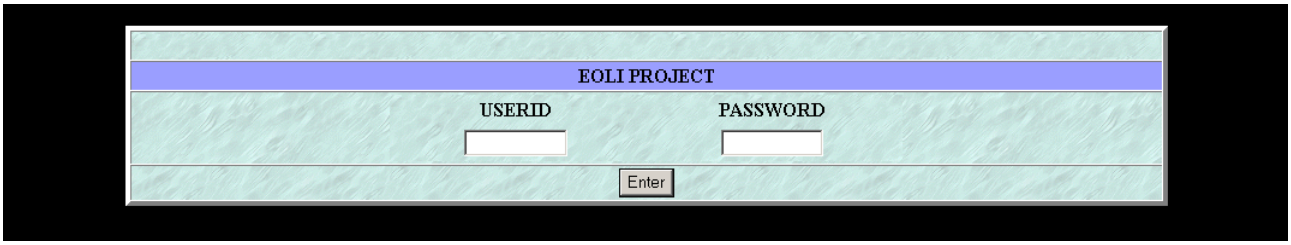


figure 2: admittance panel

We have to fill the **userid** and **password** fields with a valid account in order to enter in the site, and only the EOLI administrator is able to give these grants for the access. Anyhow a special account for a demo visit with a **userid** and a **password** both equal to **demo** is active.

If We use wrong login parameters, the system warns us with a different panel for an unauthorized attempt (*figure 3*), and We can try the access again.

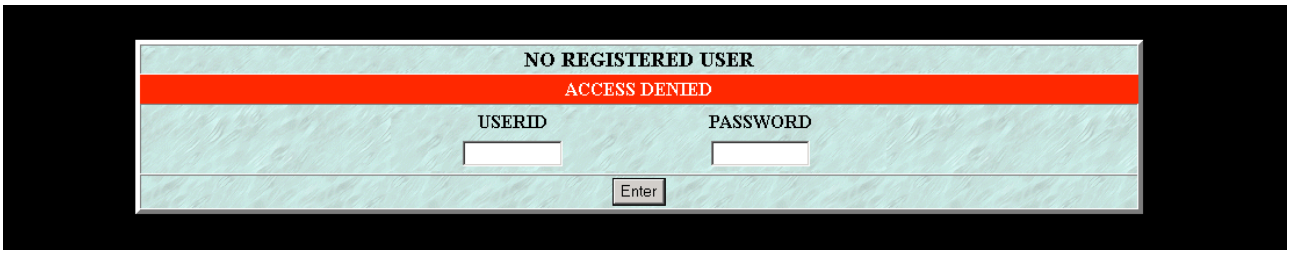


figure 3 : unauthorized panel

After We succeeded in the login, We can choose which plant We want to check: the available plants depend on the grants of access the EOLI Administrator assigned for our login account: in *figure 4* We have an example of the main panel look for two users with different grants for the access:

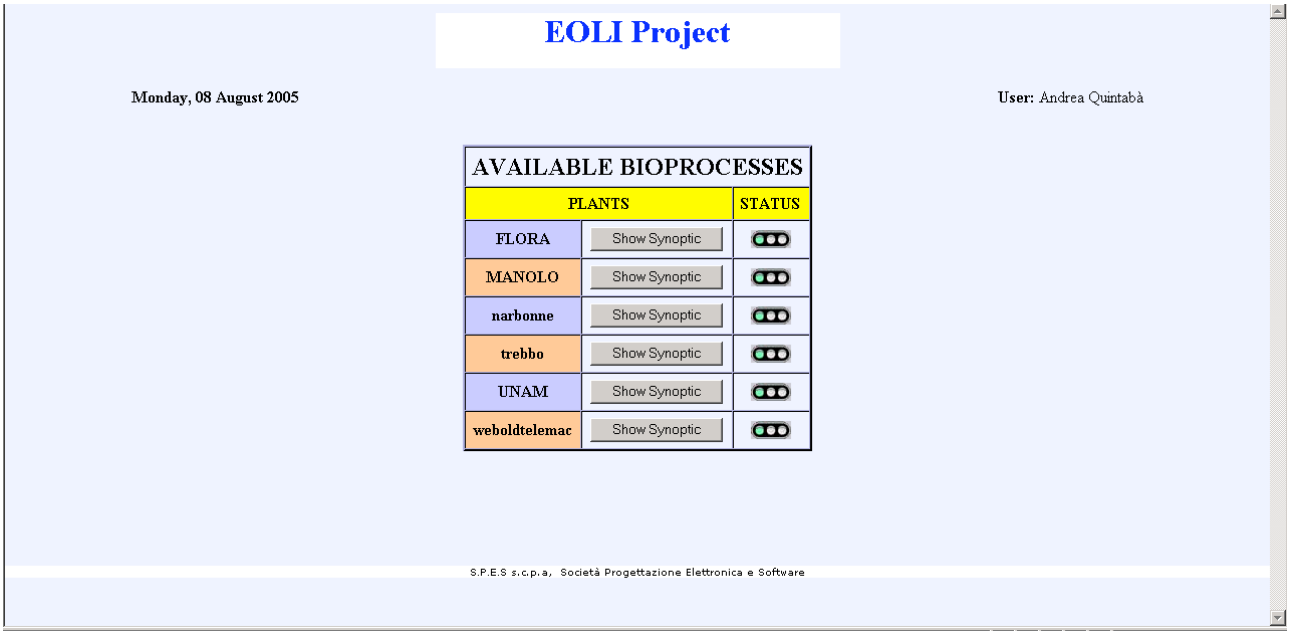


figure 4.1 : a full access to all plants

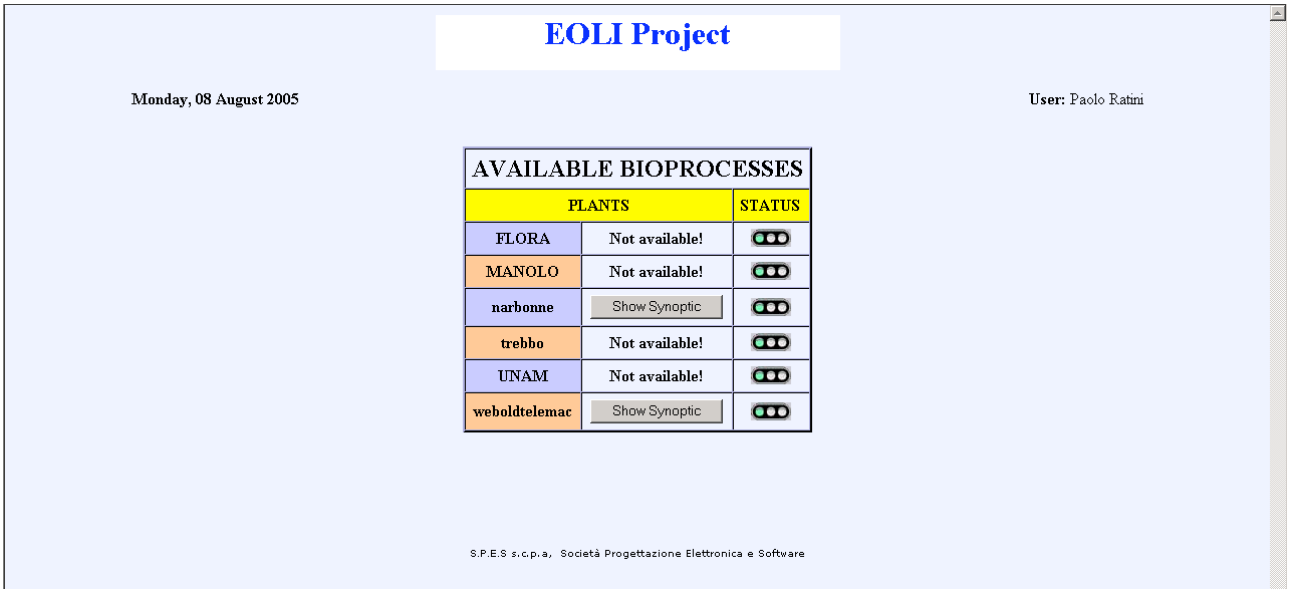


figure 4.2: a limited access to some plants

We can enter in the synoptic of one of the available plant with a click on the relative button(*figure 5*):

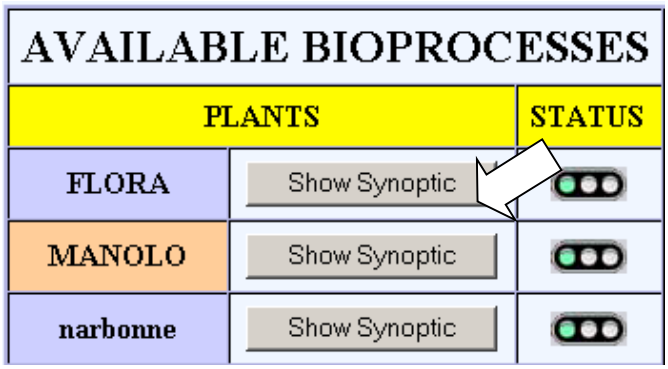
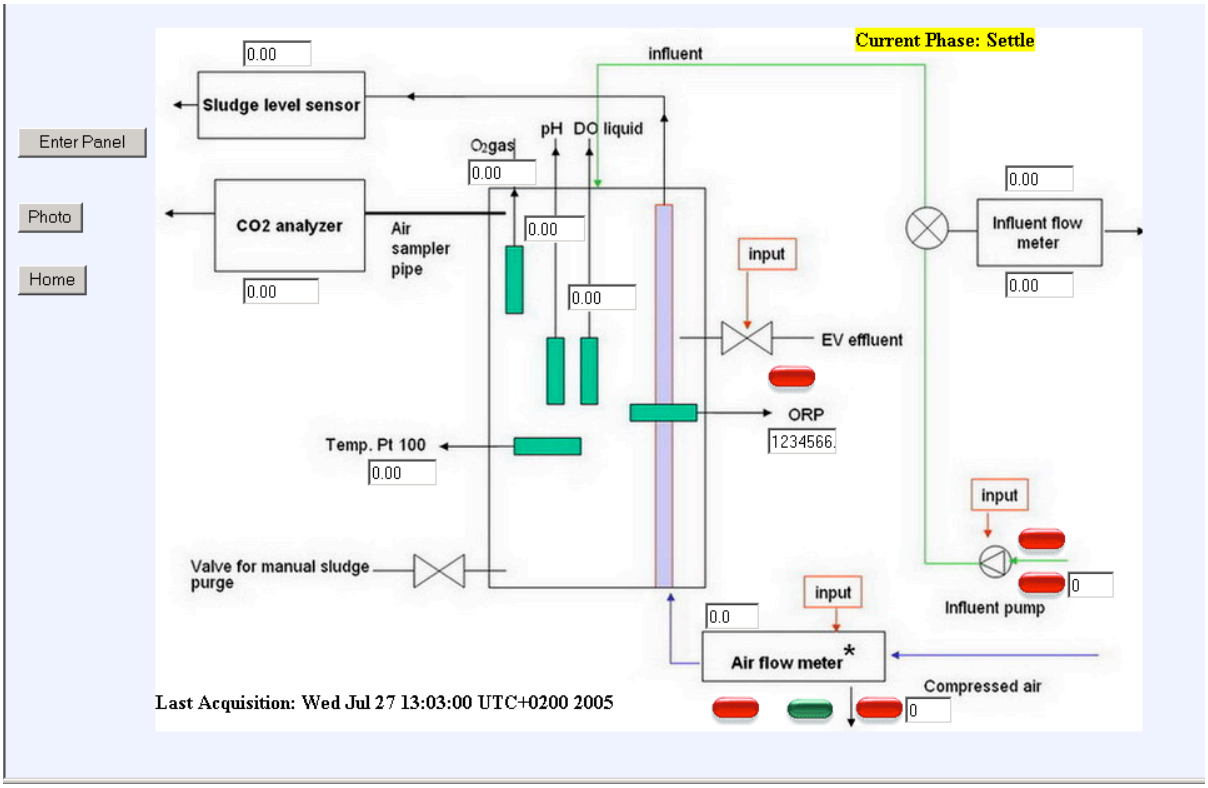


figure 5 : the panel to enter a synoptic

The synoptic present a schema of the devices and probes really in use at the selected plant with the representation of the last available data acquired. In the *pictures 6* , examples of the structure of a synoptic are presented:



picture 6.1 : Narbonne pilot plant synoptic with the location of probes and device

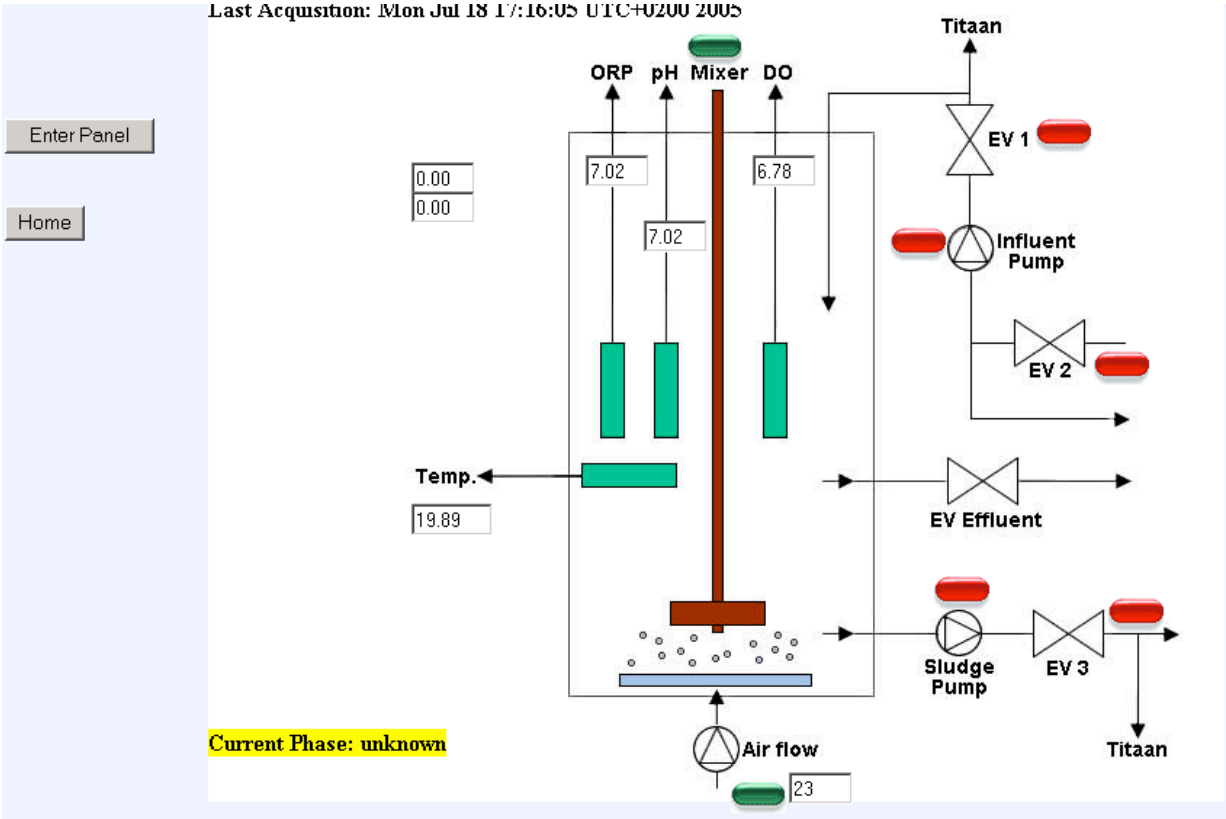


figure 6.2 : Trebbo pilot plant synoptic

The synoptic provides several control objects (text fields and leds) that displays the last available value of variables and the actual state of the actuators (GREEN: opened/activated ; RED: closed/deactivated): if We click on the control the graph of the variable during the last 8 days is shown as presented in the *figures 7*:

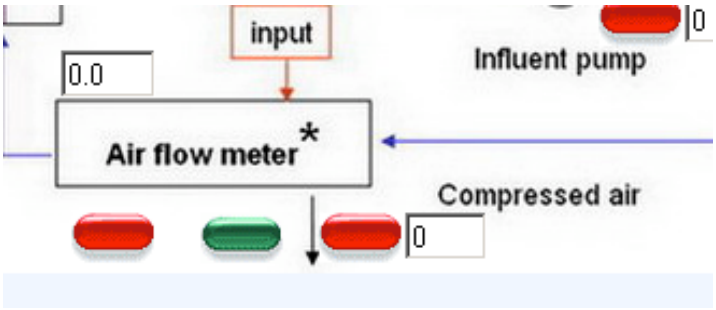
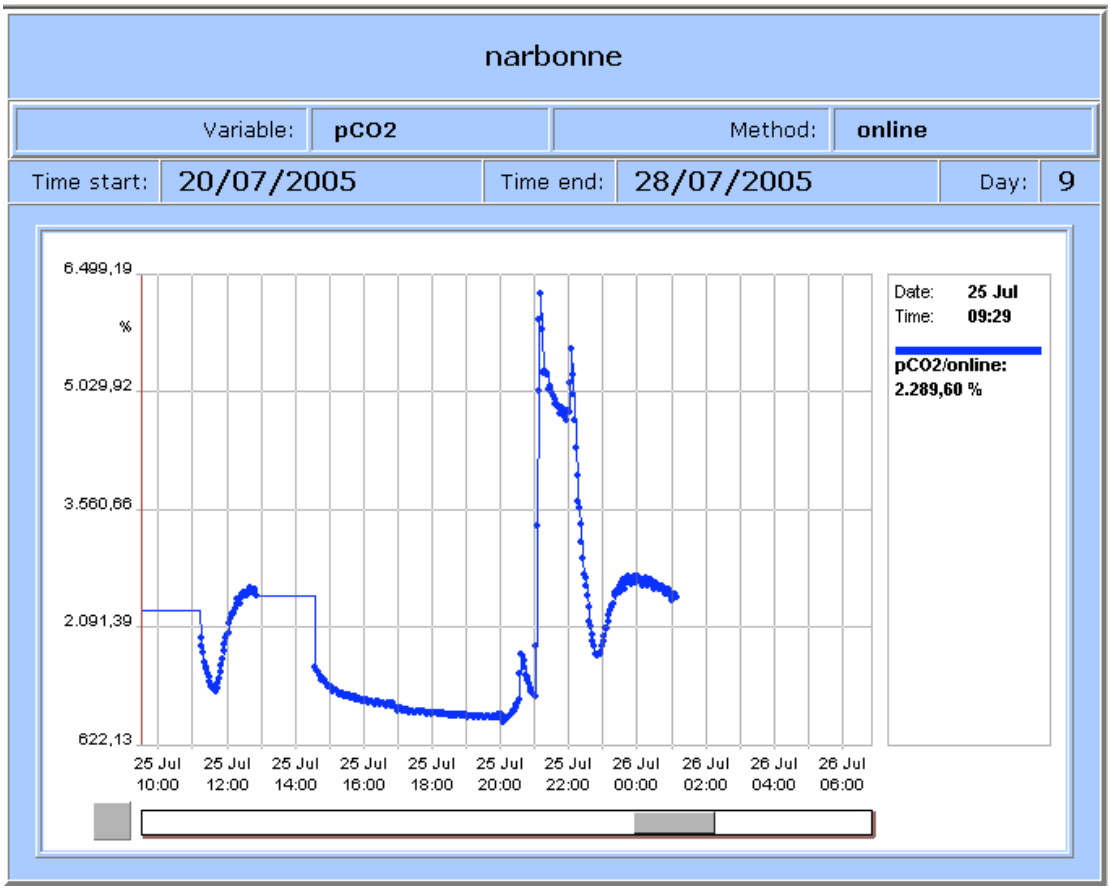


figure 7.1 : a particular of the Narbonne synoptic



picture 7.2 : the graph that appear when We click the input text in figure 7.1

This option isn't always active: in fact if the text field backcolor is red, this means that the probe/device linked to the variable isn't engaged. *Figure 7.3* show this particular case.

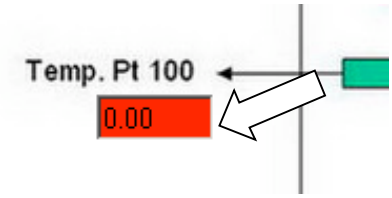


figure 7.3 : possible view of the synoptic

Clicking the **Enter Panel** button at the synoptic, We enter the main control panel of the plant that contains the TCC, the COMMAND, the DRAWING and the TABLE functionalities: according with the grants of our own access account We are qualified or not for the opening of each single functionality mentioned above.

Main Interface

A picture of the main interface of the system is shown in *figure 8.1*:

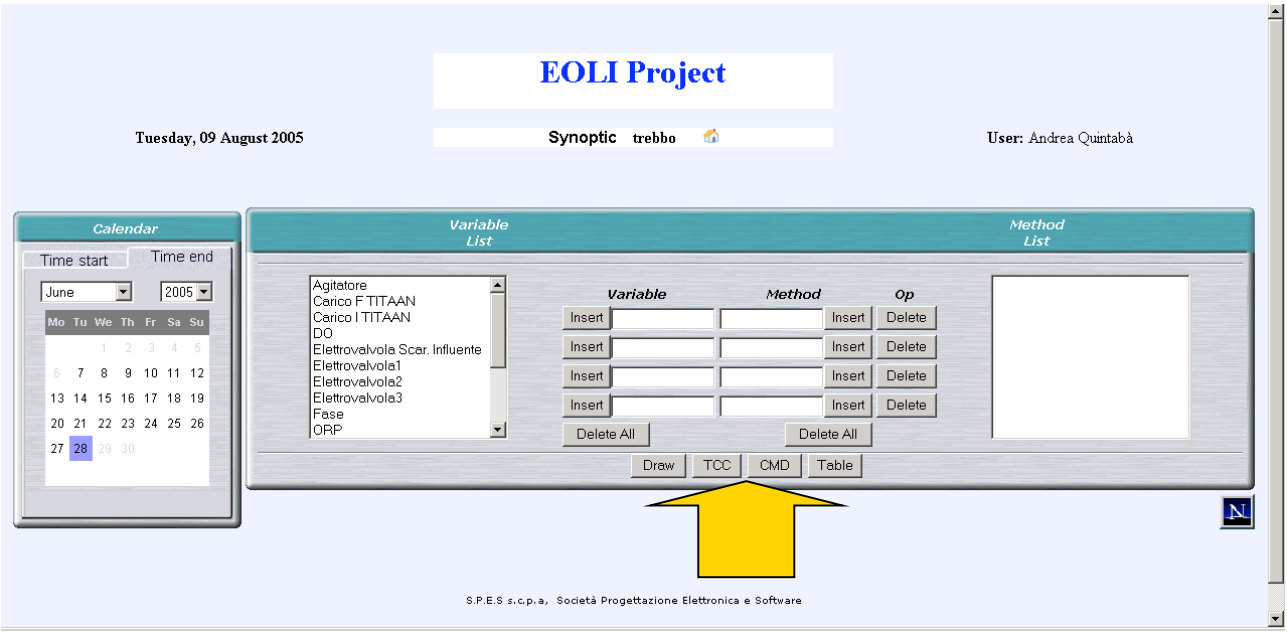


figure 8.1 : Main Tool Interface

The access to the various functionalities is provided by the buttons indicated by the yellow arrow and shown in a zoom view in the *picture 8.2* and *8.3*:

figure 8.2 : view of the command buttons of Main Tool Interface

figure 8.3 : view of the command buttons of Main Tool Interface

The remote operator is provided with as many buttons as many functionalities are enabled for his account as presented in figure 8.2 : each button opens an interface to interact with the plant.

1. **DRAW BUTTON**: Draw a new graph of the measurements.
2. **TCC BUTTON**: Open the Telemonitoring Control Center.
3. **CMD BUTTON**: Open the command dialog interface.
4. **TABLE BUTTON**: download the data of the measurements

The Calendar Control This web control let us to select the start and stop day in which We want to check the data of up to four variables measured each with its own method (figure 9.1). The control represents a standard Gregorian calendar, in which the days are shown in three different colours (figure 9.4):

- Grey colour means that the day isn't active for the selection.
- Violet colour means that the day has been selected.
- Black colour means that the day is active for the selection.

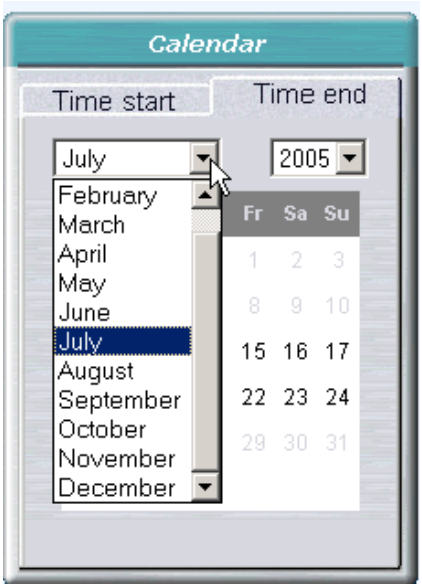


figure 9.1

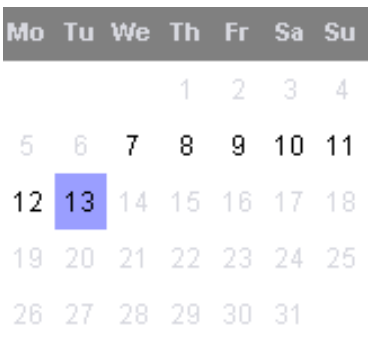


figure 9.2

In order to establish the time range for the download or to draw the data, We must first push the Time Start Button and after The Time End Button and select the day among those available in a black colour in both case. Anyway, the system chooses automatically a range of a week backwards from the time of the last acquisition.

There is also another appearance of the calendar for those web browsers that don't fully support the JavaScript technology: a picture is shown in *figure 9.3*.

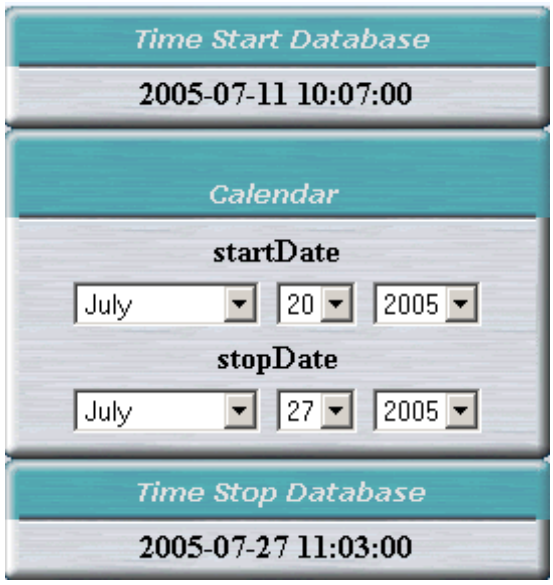


figure 9.3 the calendar for browsers different from IE explorer

The mode of operation is similar to the previous calendar but in a difference appearance. If We use the Internet Explorer Browser, We can change the appearance of the calendar pushing the icon in the bottom right part of the web page (*figure 9.4*).

figure 9.4

The Variable/Method Panel This form lets us to browse the variables available in the current plant, in order to draw online or download in our PC their values.(*figure 10.1*).Of course We have first to choose the time range in the calendar control.

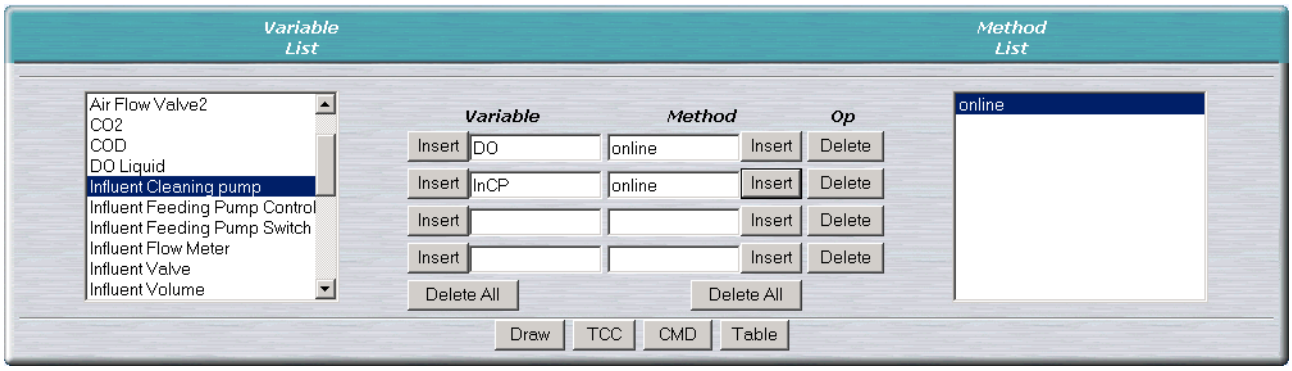
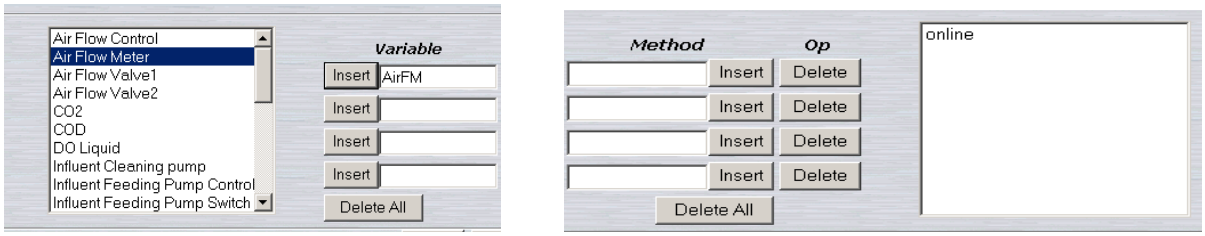


figure 10.1 : the variable/method panel.

We have to select the variable from the variable's list and after push the **Insert** button to put it in the input field as it's shown in *figure 10.2*. The same operation must be done for the method's list in which appears only the available methods for the selected variable. The **Delete** and **Delete All** buttons are useful to erase from the panel the results of our choices.



picture 10.2: the selection of a variable and his method

We can select up to 4 variables to obtain pushing the **Draw** button the graph referred to the time period selected (*figure 10.3*) or view the data as a table pushing the **Table** button (*figure 8.2*) with the option of downloading them in a txt or csv format (*figure 10.5*).

The Draw/Table Panel:

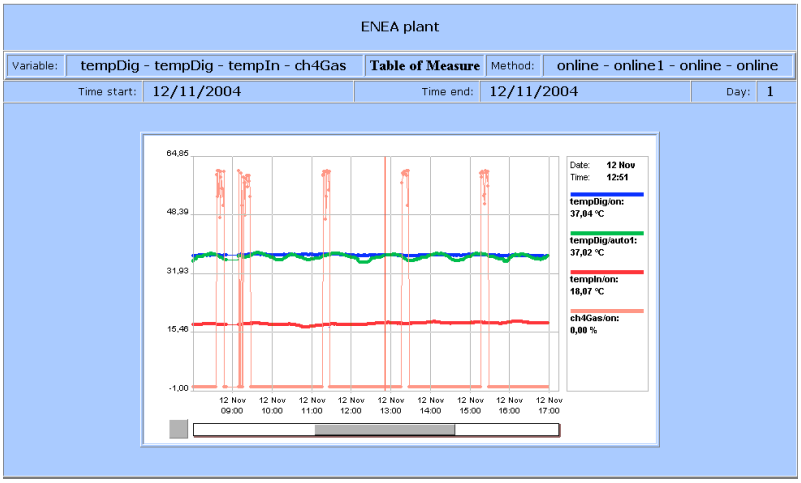


figure 10.3: the graph of 4 variables in a single day

narbonne

Variable:	DO - REDOX	Method:	online - online		
Time start:	22/09/2005	Time end:	23/09/2005	Day:	2

Office 2000 Office XP TXT file

Date	DO	REDOX
2005-09-22 00:01:00	3.658	50.967
2005-09-22 00:03:00	3.371	54.192
2005-09-22 00:05:00	3.406	56.891
2005-09-22 00:07:00	4.041	59.622
2005-09-22 00:09:00	3.675	61.390
2005-09-22 00:11:00	3.837	64.293
2005-09-22 00:13:00	3.877	66.598
2005-09-22 00:15:00	4.150	69.186
2005-09-22 00:17:00	4.327	72.182
2005-09-22 00:19:00	4.688	74.424
2005-09-22 00:21:00	5.019	78.133
2005-09-22 00:23:00	5.334	80.807
2005-09-22 00:25:00	5.767	84.204

figure 10.4:the table of data and the download buttons

data_plant.txt - Blocco note

File Modifica Formato Visualizza ?

```
DATE      tempDig/on      tempDig/auto1   tempIn/on       ch4Gas/on
2004-11-12 00:00:00       36,6952 36,6743 17,379  0
2004-11-12 00:01:00       36,6378 36,6743 17,3213 0
2004-11-12 00:02:00       36,6952 36,6168 17,3213 0
2004-11-12 00:03:00       36,6952 36,5592 17,3213 0
2004-11-12 00:04:00       36,6378 36,5017 17,2635 0
2004-11-12 00:05:00       36,6378 36,4442 17,3213 0
2004-11-12 00:06:00       36,7527 36,3867 17,2635 0
2004-11-12 00:07:00       36,6378 36,3292 17,2635 0
2004-11-12 00:08:00       36,5803 36,2717 17,2635 0
2004-11-12 00:09:00       36,5803 36,2717 17,2635 0
2004-11-12 00:10:00       36,5803 36,1566 17,2057 0
2004-11-12 00:11:00       36,6378 36,0991 17,2057 0
2004-11-12 00:12:00       36,5229 36,0415 17,2057 0
2004-11-12 00:13:00       36,4655 35,984  17,2057 0
2004-11-12 00:14:00       36,5803 35,9265 17,2057 0
2004-11-12 00:15:00       36,5229 35,869  17,2057 0
2004-11-12 00:16:00       36,5229 35,8114 17,2057 0
2004-11-12 00:17:00       36,5229 35,7539 17,2057 0
2004-11-12 00:18:00       36,5229 35,6964 17,2057 0
2004-11-12 00:19:00       36,5803 35,6389 17,2057 0
2004-11-12 00:20:00       36,6378 35,6389 17,2057 0
2004-11-12 00:21:00       36,4655 35,6389 17,2057 0
2004-11-12 00:22:00       36,5229 35,5813 17,2057 0
2004-11-12 00:23:00       36,4655 35,5813 17,2057 0
2004-11-12 00:24:00       36,5229 35,7539 17,2635 0
2004-11-12 00:25:00       36,5229 35,7539 17,3213 0
2004-11-12 00:26:00       36,5229 35,8114 17,2635 0
2004-11-12 00:27:00       36,5229 35,8114 17,2635 0
2004-11-12 00:28:00       36,6378 35,9265 17,2635 0
2004-11-12 00:29:00       36,5229 35,984  17,3213 0
2004-11-12 00:30:00       36,4655 36,0415 17,3213 0
2004-11-12 00:31:00       36,5803 36,0415 17,3213 0
2004-11-12 00:32:00       36,5803 36,2717 17,3213 0
2004-11-12 00:33:00       36,7527 36,2717 17,379  0
2004-11-12 00:34:00       36,5803 36,3292 17,3213 0
```

	A	B	C
1	DATE	vfaDig/on	
2	29/10/2004 20.01	-1,25	
3	29/10/2004 20.16	-1,25	
4	29/10/2004 20.31	-1,25	
5	29/10/2004 20.46	0	
6	29/10/2004 21.01	-1,25	
7	02/11/2004 6.46	-1,25	
8	02/11/2004 7.01	-1,25	
9	03/11/2004 6.31	-1,25	
10	03/11/2004 6.46	-1,25	
11	03/11/2004 7.01	-1,25	
12	03/11/2004 7.16	-1,25	
13	03/11/2004 7.31	-1,25	
14	04/11/2004 7.16	-1,25	
15	04/11/2004 7.31	-1,25	
16	05/11/2004 6.46	0	
17	05/11/2004 7.01	0	
18	05/11/2004 7.31	-1,25	
19	06/11/2004 7.31	-1,25	
20			
21			

figure 10.5: the format available for the download

For data downloading,We must select the file format and click the relative icon (orange arrow in *figure 10.4*).

The txt file format use ‘tab spaced’ columns and ‘line feed’ rows as separators for the values.

The data plot functionality is implemented using java technology and so the JRE environment of SUN Microsystems or the JVM Microsoft machine are requested for a correct view of the drawing (internet explorer 6.0 is already provided of JVM Machine).

In *picture 11.1* it is presented a graph of two variables.

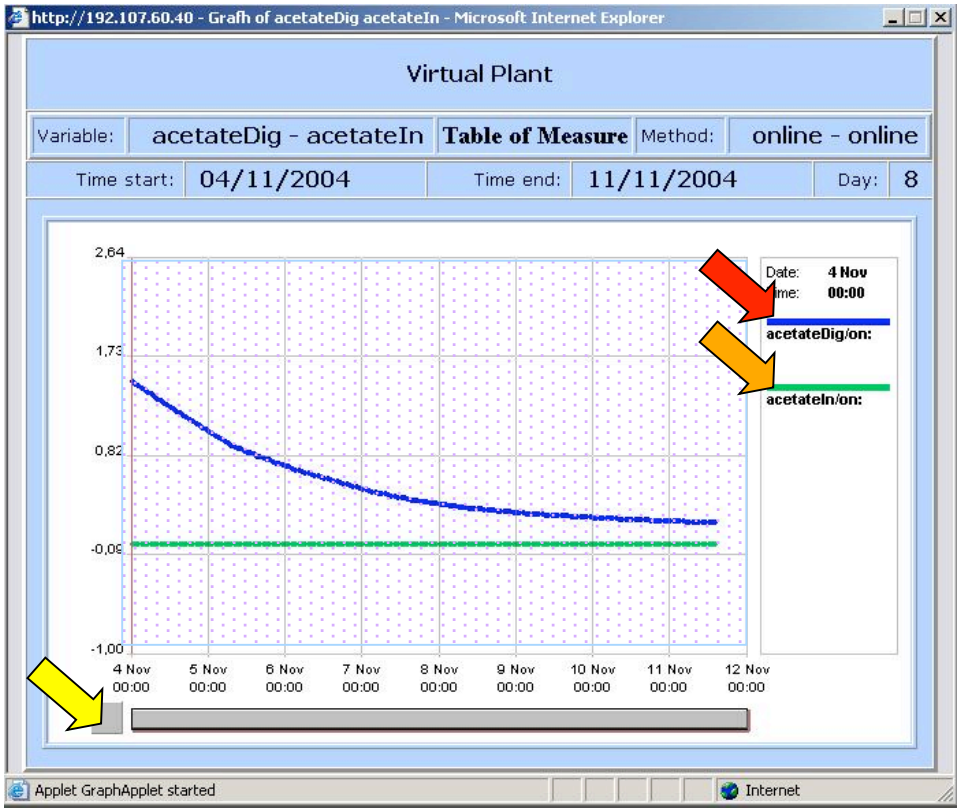


figure 11.1 : the graph applet

When We click and drag the mouse inside the active area (the rectangle in blue in the picture) the zoom function in the graph is available and a red rectangle appear on the picture to indicate the area to enlarge.

We can recover the value of a variable versus the time simply wit a click in the active area while with the left and right arrows of the keyboard We can move towards the left or the right side of the graph: the X axis reports the time range that we have selected, while the Y-axis the MAX and the MIN of the graph. The selected value of each plotted variables is reported in the right side of the panel with its measurement unit.

When We click on the colour bar in the right side of the panel (red and orange arrow) We focus the Y axis on the relative plot by the way of the change in the MIN and MAX value of the range.

When We click on the square button in the bottom left part, the graph is redraw in his original size (yellow arrow). Automatically if the selected time range of the plot is lower than 14 days the sample time is set to one minute otherwise it is fixed to 1 hour and the value plotted for the variable selected is the average one.

The dots in the plot symbolized a data, while the thin line is only used to connect two dots.

The Command Panel: When We push the **CMD BUTTON**, the Manual Command panel is opened as shown *in figure 12.1*.

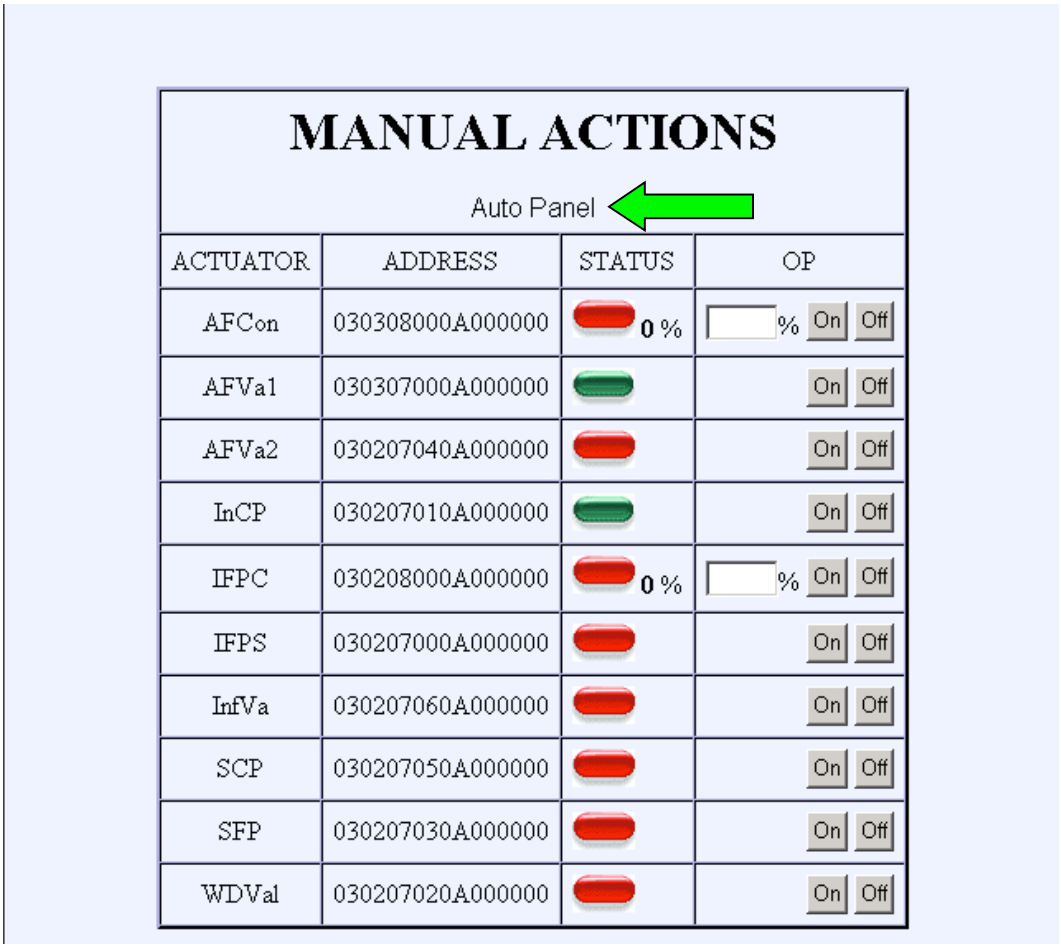


Figure 12.1 – command panel

In the command panel are reported all the actuators enrolled for the plant with their main features.

- ACTUATOR: short name of the actuator.
- ADDRESS: hexadecimal address: this information is useful for a quick check of the hardware configuration .
- STATUS: the last state of the actuator, RED – turn off; GREEN turn on. For the inverter type equipments it is also reported the last value of the control in terms of percentage vs the upper range limit.
- OP: the possible commands that We can send to the actuators at the plant. Also in this case for the inverter type actuators it is possible to choose the percentage of the control value imposed.

In addiction, We can open the **Auto Command Panel**, through a click on the link shown by the green arrow in *figure 12.1*: the new panel is shown in the *figure 12.2*. This panel is used to send scheduled commands and actions to the plant: in fact, here We have to select the start and stop date

and time of the new action, in addiction with the state of the actuator. This operation is allowed for all the actuators currently enrolled at the plant.

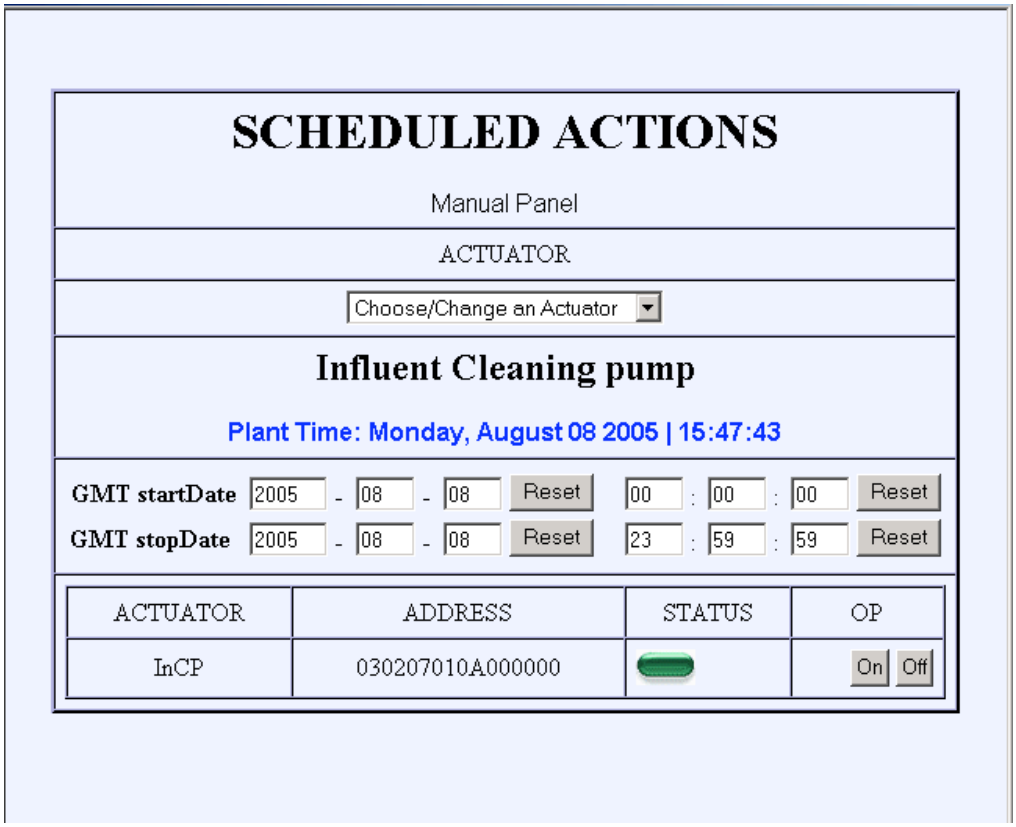


Figure 12.2 – the auto command panel

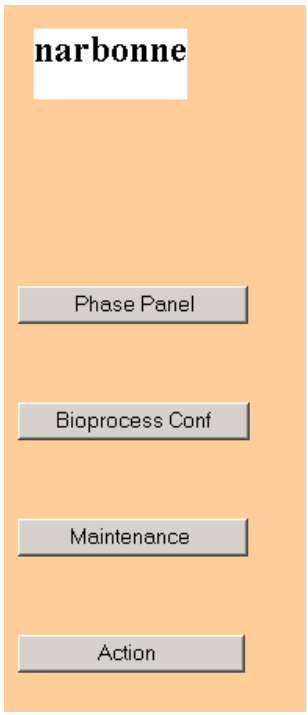
Is important to remember, that all this command and actions remotely scheduled are sent to the plant only when the local software (the SPES Gateway) opens a new connection with the remote server for the download of the data: so if the local operator has scheduled the upload every hour, the new commands that remote expert has scheduled now will be communicate with a maximum time lag of a hour!

The TCC Panel:

A picture of the panel is shown in *figure 13.1*.

Figure 13.1 - TCC interface

In the left side, We have the menu bar with all the possible operations that can be done as shown in *figure 13.2.*



1. **Phase Panel**: it is the panel that shows the phase of the SBR process.
2. **Bioprocess Conf**: it is the panel that shows the actual configuration of the plant.
3. **Maintenance**: it is the panel recording all the maintenances action applied to the plant.
4. **Action**: it is the panel that shows all the actions applied to the bioprocess.

Figure 13.2

- **Phase Panel**

A picture of the panel is shown in *figure 13.3*.

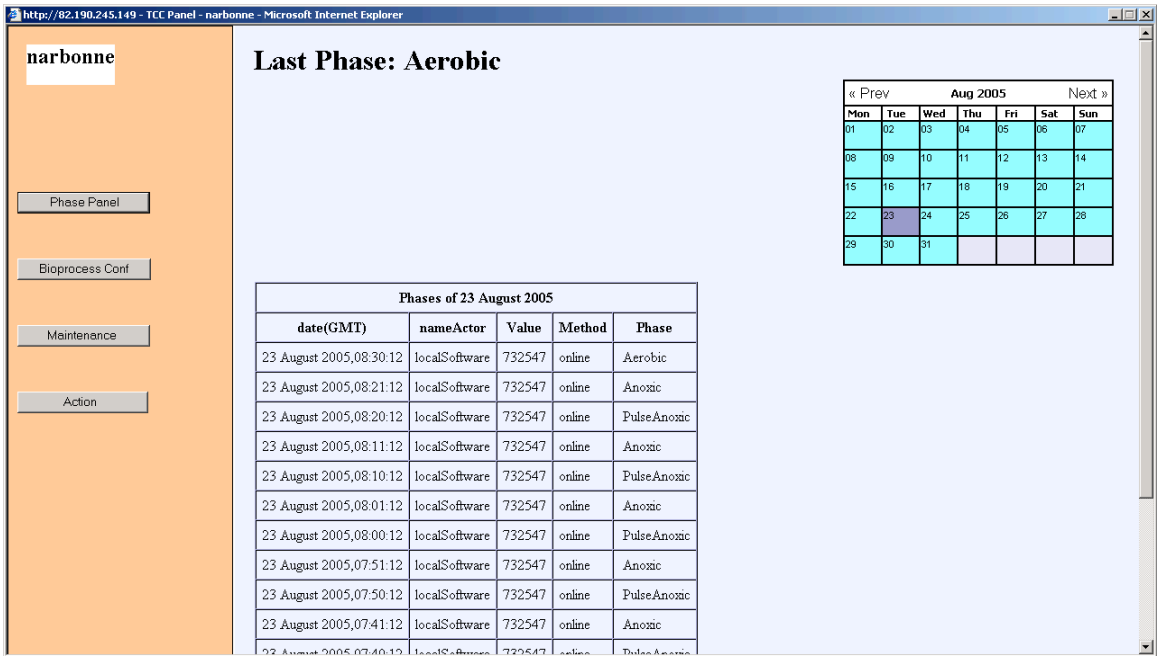


Figure 13.3 – phase panel

As We can see in the figure above, when We open this panel the phases' schedule of the current day are shown, and We can load through the calendar in the upper right corner, the schedule of a particular day selecting the date by a simple click (view *figure 13.4*).

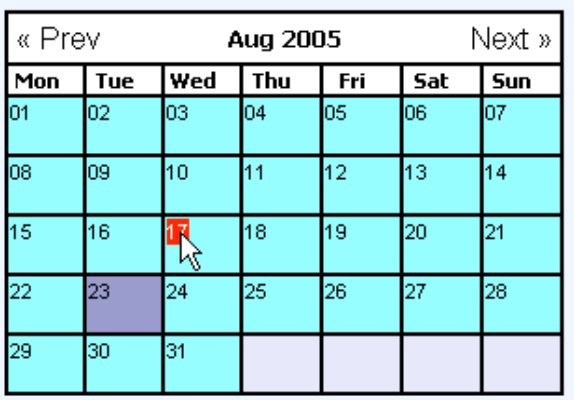
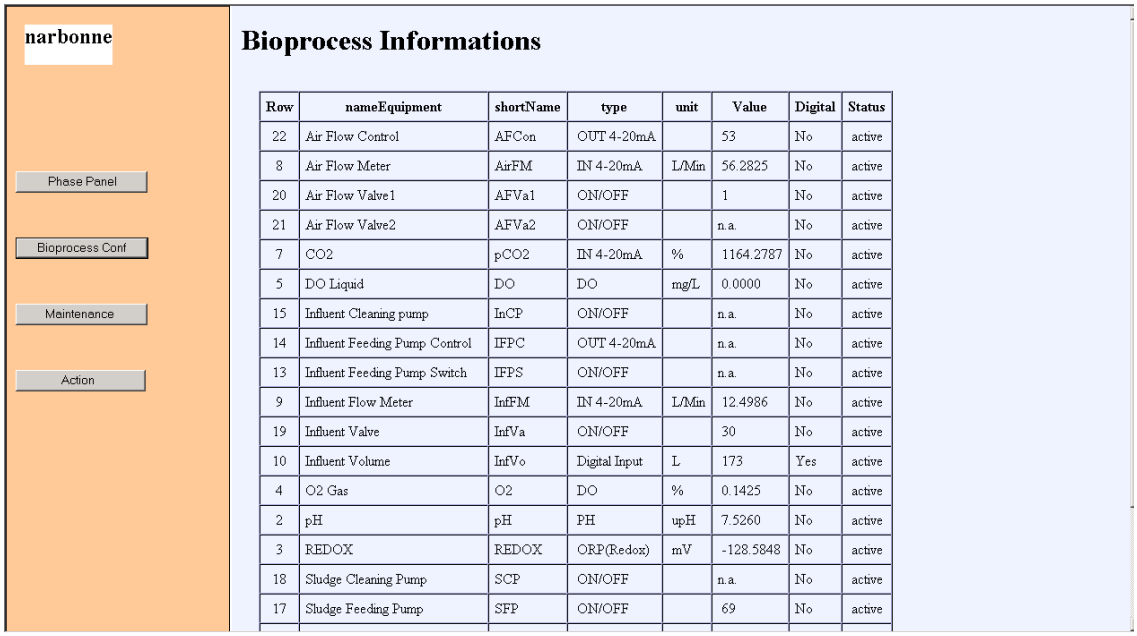


Figure 13.4 – calendar

- **Bioprocess Conf**

A picture of this panel in shown in *figure 13.5*.



Row	nameEquipment	shortName	type	unit	Value	Digital	Status
22	Air Flow Control	AFCon	OUT 4-20mA		53	No	active
8	Air Flow Meter	AirFM	IN 4-20mA	L/Min	56.2825	No	active
20	Air Flow Valve1	AFVa1	ON/OFF		1	No	active
21	Air Flow Valve2	AFVa2	ON/OFF		n.a.	No	active
7	CO2	pCO2	IN 4-20mA	%	1164.2787	No	active
5	DO Liquid	DO	DO	mg/L	0.0000	No	active
15	Influent Cleaning pump	InCP	ON/OFF		n.a.	No	active
14	Influent Feeding Pump Control	IFPC	OUT 4-20mA		n.a.	No	active
13	Influent Feeding Pump Switch	IFPS	ON/OFF		n.a.	No	active
9	Influent Flow Meter	InfFM	IN 4-20mA	L/Min	12.4986	No	active
19	Influent Valve	InfVa	ON/OFF		30	No	active
10	Influent Volume	InfVo	Digital Input	L	173	Yes	active
4	O2 Gas	O2	DO	%	0.1425	No	active
2	pH	pH	PH	upH	7.5260	No	active
3	REDOX	REDOX	ORP(Redox)	mV	-128.5848	No	active
18	Sludge Cleaning Pump	SCP	ON/OFF		n.a.	No	active
17	Sludge Feeding Pump	SFP	ON/OFF		69	No	active

Figure 13.5 – bioprocess panel

The purpose of this panel is limited to check the correct status of the plant: actually the table reports the main parameters of all the devices – sensors and actuators – in use at the plant for the control of the bioprocess: an expert operator can have an instant snapshot of the system in case he eventually has to take decisions or to implement some actions.

- **Maintenance**

The panel reports a simple summary of all the maintenances executed at the plant.

- **Action**

As for the maintenances, but all the actions done can be viewed divided by date selectable on the calendar (*figure 13.6* and *13.7*).

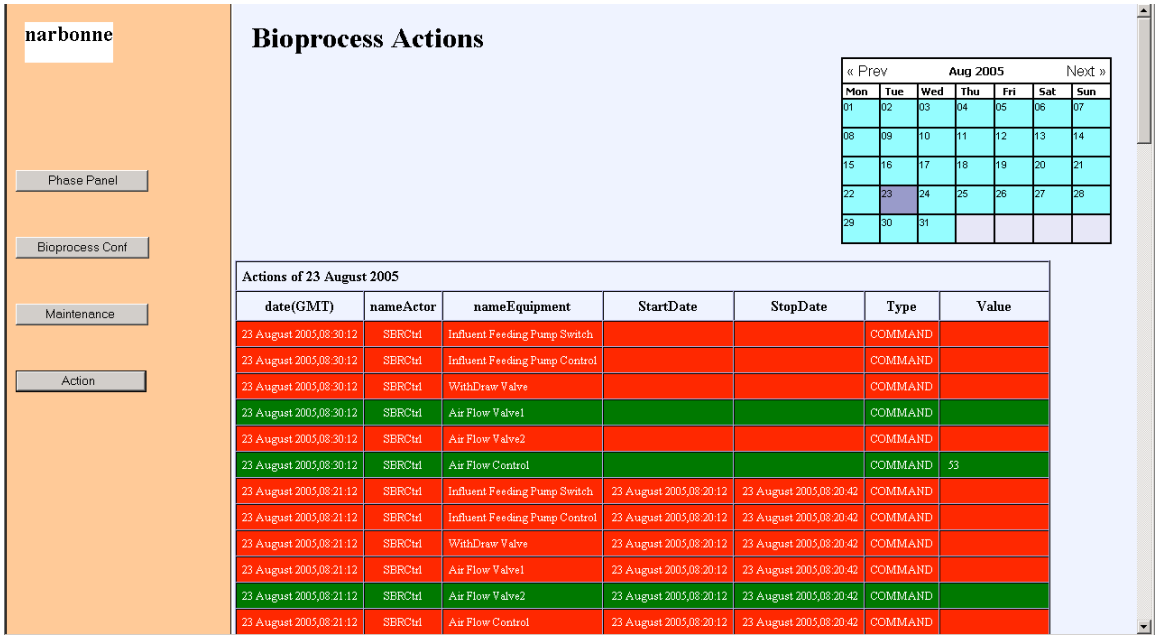


Figure 13.6 - action panel

Actions of 23 August 2005

date(GMT)	nameActor	nameEquipment	StartDate	StopDate	Type	Value
23 August 2005,08:30:12	SBRCtrl	Influent Feeding Pump Switch			COMMAND	
23 August 2005,08:30:12	SBRCtrl	Influent Feeding Pump Control			COMMAND	
23 August 2005,08:30:12	SBRCtrl	WithDraw Valve			COMMAND	
23 August 2005,08:30:12	SBRCtrl	Air Flow Valve1			COMMAND	
23 August 2005,08:30:12	SBRCtrl	Air Flow Valve2			COMMAND	
23 August 2005,08:30:12	SBRCtrl	Air Flow Control			COMMAND	53
23 August 2005,08:21:12	SBRCtrl	Influent Feeding Pump Switch	23 August 2005,08:20:12	23 August 2005,08:20:42	COMMAND	
23 August 2005,08:21:12	SBRCtrl	Influent Feeding Pump Control	23 August 2005,08:20:12	23 August 2005,08:20:42	COMMAND	
23 August 2005,08:21:12	SBRCtrl	WithDraw Valve	23 August 2005,08:20:12	23 August 2005,08:20:42	COMMAND	
23 August 2005,08:21:12	SBRCtrl	Air Flow Valve1	23 August 2005,08:20:12	23 August 2005,08:20:42	COMMAND	
23 August 2005,08:21:12	SBRCtrl	Air Flow Valve2	23 August 2005,08:20:12	23 August 2005,08:20:42	COMMAND	
23 August 2005,08:21:12	SBRCtrl	Air Flow Control	23 August 2005,08:20:12	23 August 2005,08:20:42	COMMAND	

Figure 13.7 – particular of the action panel

Administration Interface

For the administration of the remote access, another tool is implemented in terms an internet connection in the same way of the EOLI remote interface: We have to fill the URL of our browser with the right address (*figure 14.1*).

figure 14.1

This area is available only under EOLI administrator's grants and the login panel is shown in *figure 14.2*.

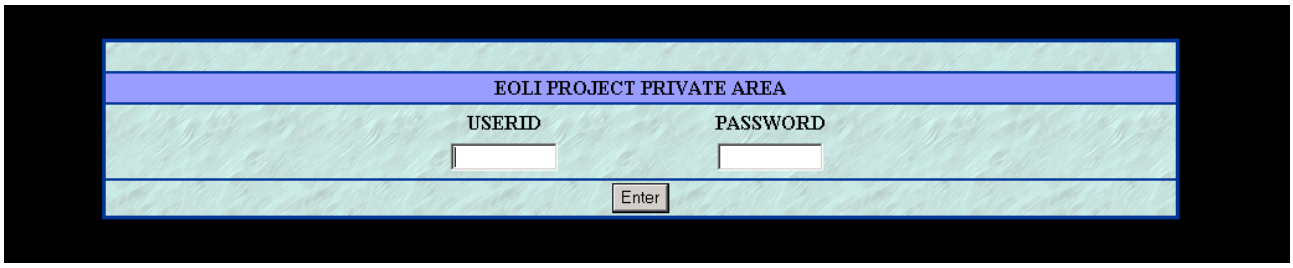


figure 14.2

If We are authorized to access this area, the main panel appears with the list of the possible operations that can be done (*figure 14.3*).

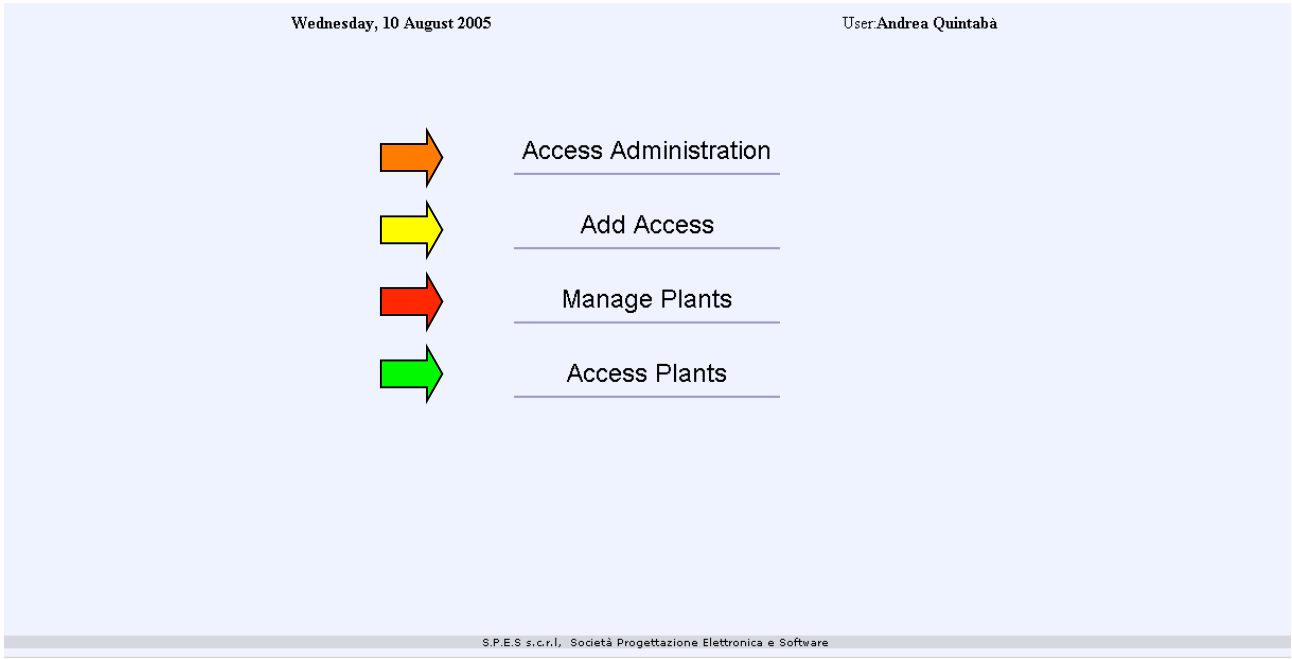


figure 14.3 : the main administrator interface

We can view the updated users' list (*figure 14.4*) and their access grants by a click on the **Access Administration** link (orange arrow in *figure14.3*).

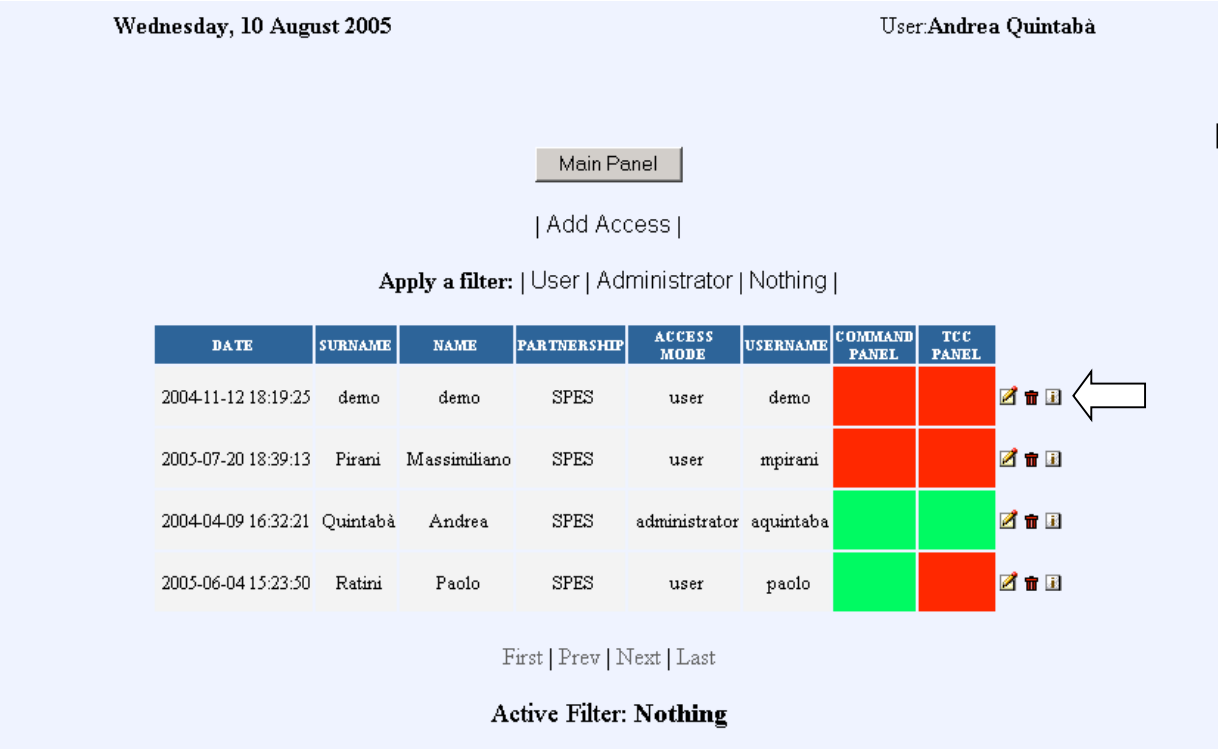


figure 14.4: the users panel

In this panel We can also filter the users on the basis of their grants or modify/delete/view each account (white arrow in *figure 28.2*).

We can add a new account for a new user by a click on the **Add Access** link (Yellow arrow in *figure 28.1*).The panel used to manage this task is shown in *figure 28.3*.

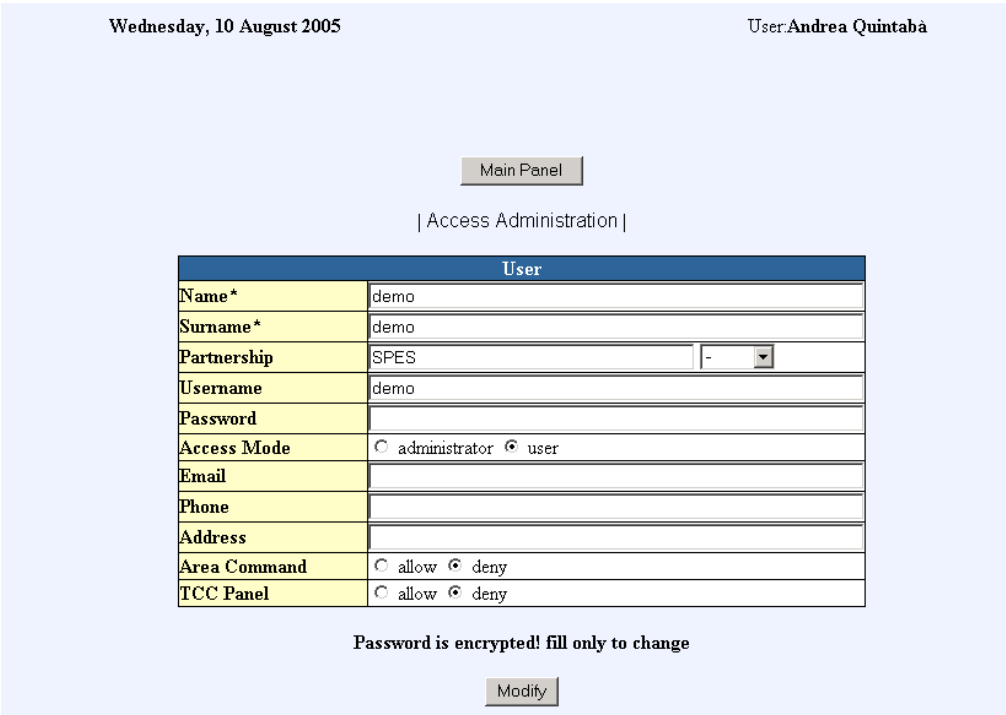


figure 14.5 : form user panel for adding a new account

By the way of this interface We can set several parameters concerning with the access grants assignment:

1. **Access Mode**: only the administrator mode can ensure the access to this area, while the user mode accesses only to the remote interface area.
2. **TCC Panel**: this option establishes if the user has access to the TCC remote interface.
3. **Area Command**: this option establishes if the user account has access to the Control Panel interface.

The other parameters are the personal data of the user.

After that We have added a new user account, We must state which plants, among those logged to the EOLI system, (*figure 14.6*) this user can access: this can be done through the panel that can be open by a click on the **Access Plants** link in *figure 14.3* (green arrow).

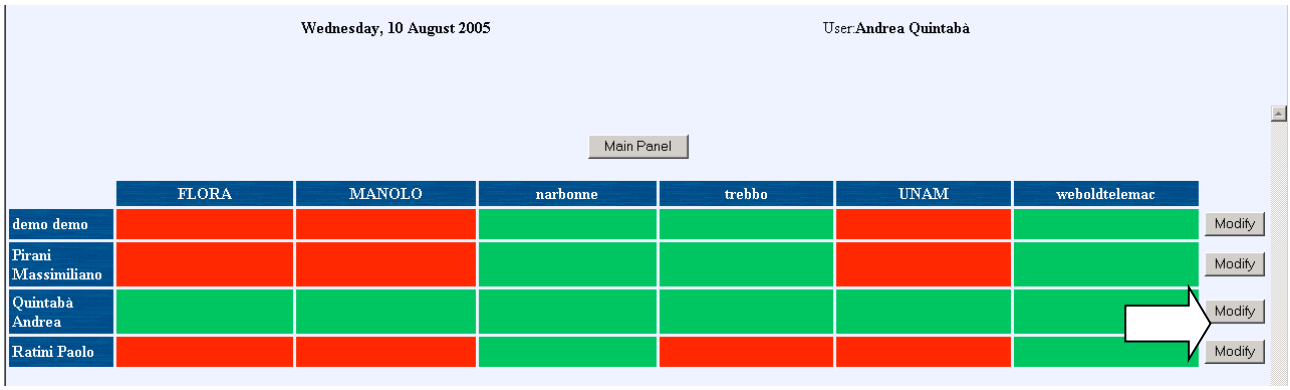


figure 14.6 : the access to the EOLI plants of each user

We can change the status of access for each user by a click on the **Modify** button that open the setup panel of the plant (*figure 14.7*). *Allow option* grants the access to the plant selected; the *Deny option* block the access to the bioprocess.

In this interface, We can also establish the role and the priority of the user on each plant.
The red or green cell symbolizes the status of access (red means deny, green means allow) for the user to the particular plant.

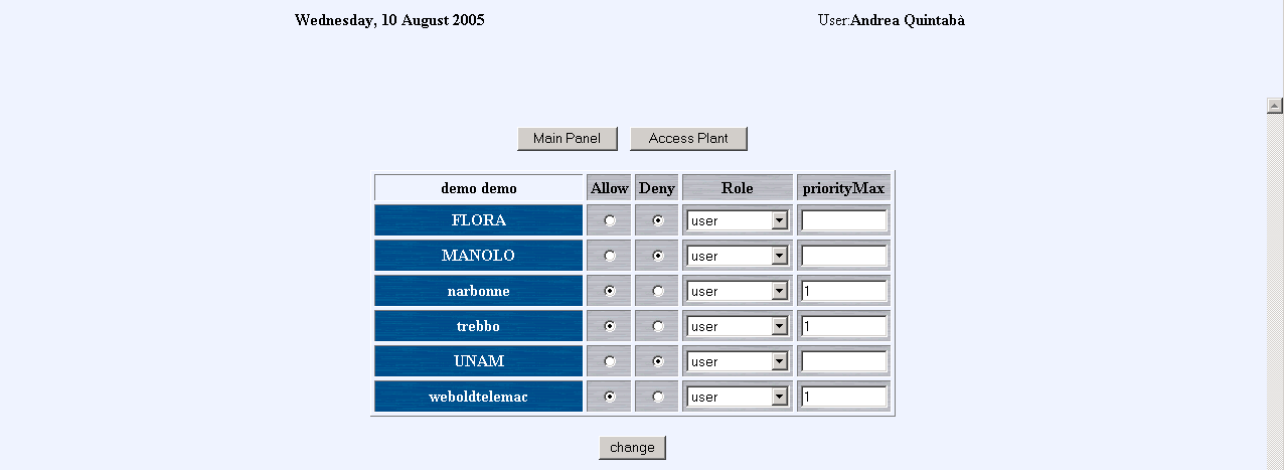


figure 14.7 : the access panel interface

Conclusions

This deliverable document has presented the full functionality of the EOLI software at both local and remote levels in the form of a user guide, describing all the features that are available for monitoring and managing a plant and administering the system. A very wide range of functions is available to local users and remote users connecting by internet.

The EOLI local software allows a full range of actions to be performed by the user, including:

- establishing communication with the plant;
- handling measurements;
- handling other tasks on plant such as maintenance;
- managing controllers;
- plotting data.

The remote interface also allows a range of operations on a plant, appropriate to the telecontrollers who will probably be situated at a different location. Depending on the privileges they may access the database and take some actions. There is also an EOLI administrator interface for setting up users and privileges.

The remote interface, accessible from anywhere in the world over the internet, allows plotting or download of data.

As well as serving as a user guide, this document is a record of the EOLI software development done within the project in its final form.