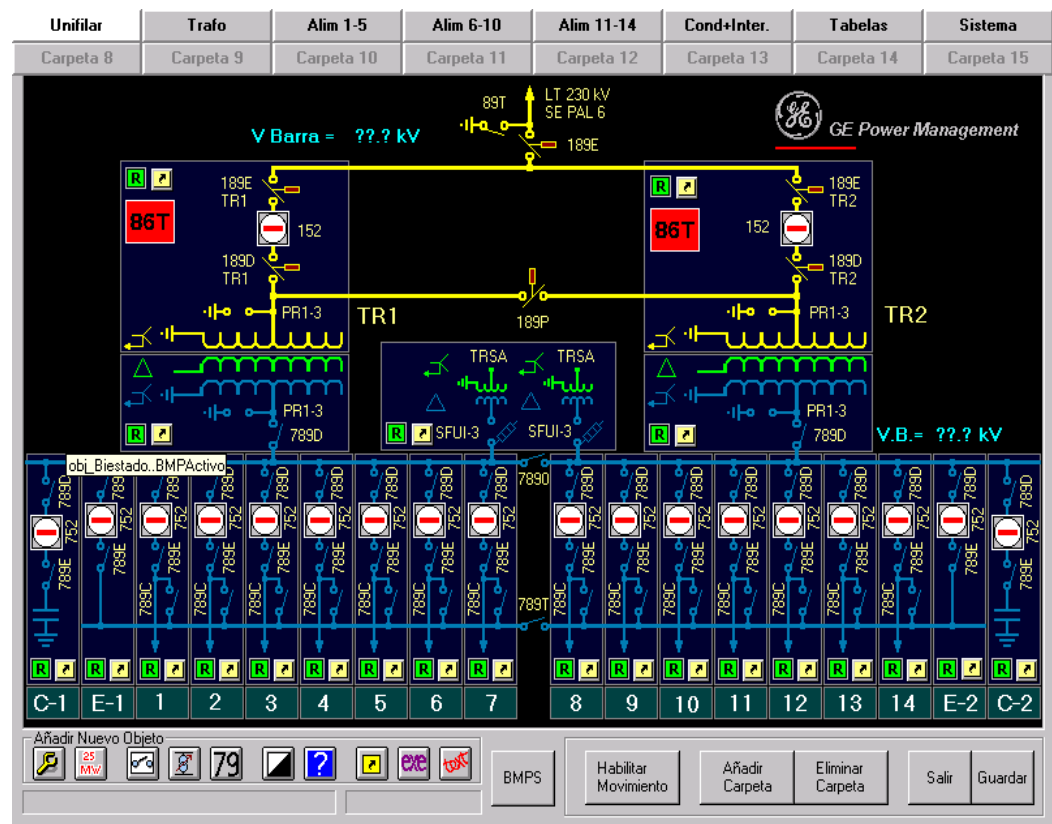# GE Power Management

Configuration Software for Electrical Substations
GE-CONF

Instructions
GEK-106274

Anything you can't find?

Anything not clear enough?

IF YOU HAVE ANY COMMENT ON THE CONTENTS OF THE PRESENT MANUAL, KINDLY FAX US A COPY OF THIS PAGE TOGETHER WITH A COPY OF THE PAGE WHERE YOU HAVE FOUND THE PROBLEM, TO THE FAX NUMBER +34 94 485 88 45 FILLING IN THE QUESTIONAIRE BELOW. WE WILL BE HAPPY TO SOLVE YOUR DOUBTS, AND WE THANK YOU FOR HELPING US IMPROVE THIS MANUAL.

Company: _____

Name: _____

Address: _____

Phone:_____ *Fax:* _____

E-mail: _____

Description of your question or suggestion:

Manual GEK code: _____

_____

_____

_____

INDEX

1   *HARDWARE REQUIREMENTS*

The minimum PC hardware requirements to run and install the GE_CONF
Software consists of the following components:

- A PC Pentium II or compatible
- A minimum of 64 Mbytes of free RAM memory (128 Mbytes is recommended)
- High-density 3 ½ inch floppy drive.

2 *GETTING STARTED*

Restart Windows program and close all the open applications before trying to install GE_CONF.

The program is provided either in several diskettes or in a CD-ROM. For first time installation follow these steps:

1. Insert the first diskette, or the CD-ROM.

2. From "Windows File Manager" run the program "a:\setup.exe" in case of diskettes, or "d:/setup.exe" in case of a CD.

3. Follow the instructions shown in the dialog box of the setup program.

4. It is not necessary to create a subdirectory for the GE_CONF program.

5. During the installation process all necessary subdirectories will be created by the installation procedure.

6. WINDOWS automatically creates the GE_NESIS group window. This group window contains the GE_CONF icon.

As we finish the installation, we can verify that the GE_CONF is part of the GE_NESIS group. The installation software creates a directory named C:\GE_NESIS\L2\GE_CONF. In this sub-directory, we will find the following files, necessary for the correct operation of the software:

PLANTI.mdb $\Rightarrow$ Database template for creating the Substation database.

PLANTI.lst $\Rightarrow$ File used for running the option "**Create Substation disks**" from the **Tools** menu.

CONF.ini $\Rightarrow$ This file is used for learning the paths for the different files, as well as the language chosen by the user.

LANGUAGE $\Rightarrow$ The program stores here which language GE_CONF has last used, so that next time it is run, it will use the same language. If this field is empty, the default language will be "Español" (Spanish).

BMP_path $\Rightarrow$ This file indicates the path for storing the BMP files. The default path will be C:\GE_NESIS\L2\GE_POWER\BMP\.

CNF_path $\Rightarrow$ This file shows the path where the relay configuration files (*.cnf) are stored. The default path is C:\GE_NESIS\ GE_INTRO\WORK\.

BMP_Editor $\Rightarrow$ In order to access the BMPs editor from the GE_CONF without exiting the program, the editor path can be indicated, as well as its name and extension.

BMP_Browser $\Rightarrow$ Here the Browser path, name, and extension can be indicated.

3   *TERMS AND DEFINITIONS*

We need to be familiar with a few basic terms that are used through this manual.

Click:	Quickly press and release the mouse button.
Drag:	Hold down the mouse button while moving the mouse.
Double Click:	Click the mouse button twice in rapid succession.
Dialog Box:	A pop-up window used for various purposes.
Message box:	A simple dialog box that contains a message and one or more push buttons.
Level 1:	Includes all the Protection, Control and Monitoring devices (relays, PLC´s, Meters, etc.) used in the Substation.
Level 2:	Includes all the elements used in the Substation to collect and process the information received from the Level 1 (Substation Computer or CONCENTRATOR, modem, GPS, screen, etc.).
Level 3:	SCADA (Supervisory Control Data Acquisition).
IED:	Intelligent Electronic Device. It refers to all the elements with information process and communication capability.
DDS:	Integrated Protection & Control devices (IED) used in the Substation level 1. There are different multifunction device models, such as: DMS (Multifunction Protection & Control module), SMOR (Multifunction bay protection), DBF (multifunction breaker failure protection), and DTP (Multifunction Generator & Transformer protection). DTR (OLTC voltage regulator), MOV (Circuit Breaker controller).
ALPS:	Integrated multifunction Line Protection and supervisory device with communication capability.
RTU:	Remote Terminal Unit (level 2) used to collect non-processed information in the Substation. In the current system, this name is associated with the level 2 or CONCENTRATOR.
FAC:	Data broadcasting module used to connect several DDS modules (up to 16) with the computer, using a single serial communication port.

4 *INTRODUCTION*

GE_CONF is a database and graphics editor software (part of the GE_NESIS suite software) for Utility and Industrial Electrical Substations. GE_CONF allows to create the Configuration database of a Substation, so that the GE_POWER (the other software package part of the integrated GE_NESIS suite software used for the on-line control and monitoring of the Substation) can read all the user-configured information from the Substation, in order to control it in local or remote mode.

The database will be obtained from the relays' configuration and database files. Those files are created for each relay using GE_INTRO software. GE_CONF reads this information and integrates it with the different objects (Switches, Circuit Breakers, etc.) defined in the Substation, creating a new graphical database that can be read and managed by GE_POWER and the level 2 Computer Manager. In the same way, GE_CONF allows to define the information that will be sent to other levels (mainly to the SCADA). We recommend reading the GE_INTRO Instruction manual (GEK-105594).

There are three steps that the user must follow to use GE_CONF:

1. As the configuration of each DDS family level 1 device is completed, the user will add the device or devices to the Substation. From the configuration file and from the database of each level 1 device (generated by the GE_INTRO for each relay or IED), GE_CONF will add the corresponding data in the database. In this way, the substation database will be composed by the addition of the different pieces of information that contains each line or bay. The pieces of information are the device status, events, measures, etc.

2. After step 1, it will be necessary to prepare the configuration of the system to match with the requirements of level 3 (SCADA). This is done by identifying the pieces of information from each level 1 unit with the RTU number assigned and with the rest of characteristics, for the correct operation of the level 2 device (CONCENTRATOR).

3. Finally, it will be necessary to build the configuration of the level 2, in order to prepare the system to be controlled and monitored by the GE_POWER. This action is done representing each object (device status, measures, etc.) by their corresponding dynamic symbol.

In order to understand better the effect of a correct configuration on the GE_POWER and on the level 2 device (CONCENTRATOR), please refer to Annex 1, which describes the different tables that compose the Substation database, and the use of this database by both programs.

In order to build properly the configuration of the characteristics of the RTU in the system (characteristics related to the communication through the SCADA), it is important to take into account the communication protocol used in the application. The RTU numbers, groups and other configurable data must fulfill the requirements of the communication protocol. Otherwise, it will not be possible to get a correct communication with the SCADA and in several cases the level 2 CONCENTRATOR will not be able to start its operation and will display a configuration error message.

The main advantage of the present GE_CONF version (2.0) is the capability to manage not only the DDS system units, but also the multifunction Line Protection System model ALPS. This feature gives the system the possibility to be used in High Voltage and EHV Substations.

5   *MAIN SOFTWARE MENU*

In order to better understand the whole functionality that the GE_CONF offers to build the Substation configuration database, we will first describe briefly the Main Window, for getting an overview of the software. After that, we will describe in detail the other sub-menus that are included in this software package.

The Main Window appears when the program starts running. On the top of the screen we will see a Menu with 6 options or Submenus: **File, Substation, System, Graphical Configuration, Tools and Help.**

5.1   FILE

If we select the **File** option, the Menu corresponding to the Files Manager will be displayed.
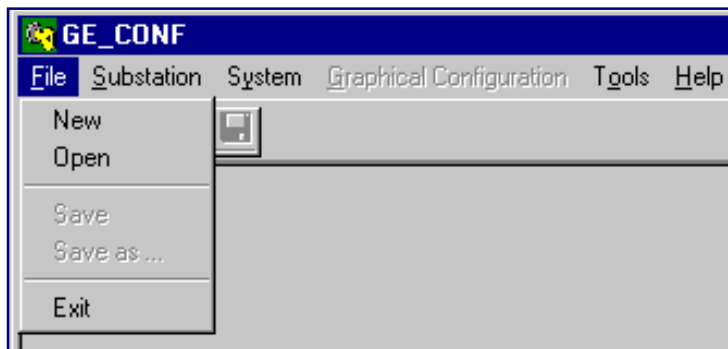
New: Create a new file.

Open: open an existing file.

Save: Saves the current working file.

Save as: Saves the current working file with a new name selected by the user.

Exit: Exits the program

5.2 SUBSTATION

If we select the **Substation** option, a Menu with the following options is displayed:
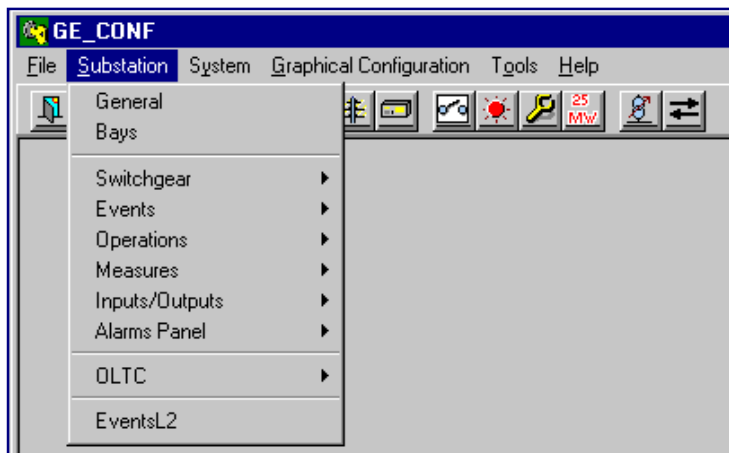
General: Defines the Substation General Data

Bays: With this option we can define the different devices existing in the Substation that will be integrated in the level 2. From the level 1 configuration files, we will generate the structure for the Substation database.

The following Information tables are the result of linking the configurations of the different devices in the Substation. Through these tables, all the information from the diverse equipment is organized to be customized by the user in Levels 2 and 3.

Switchgear, Events, Operations, Measures, Inputs/Outputs, Alarms Panel, On Load Tap Changer and Level 2 Events.

5.3 SYSTEM

In this Menu the general characteristics of the **System** related to the GENERAL SYSTEM TABLES are configured.
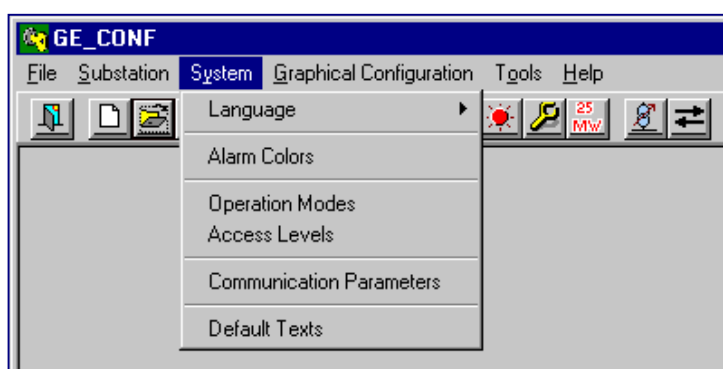
Language:	Select the language.
Alarm Colors:	Select the Alarm Colors, as they will appear on the screen. The color will depend on the alarm status. In this option we can also enable or disable the beep corresponding to the different alarm priorities.
Operation Modes:	The functions allowed for each operation mode are configured.
Access Levels:	The access levels (up to 10) and the associated operation modes can be configured in this option.

Communication Parameters:	Communication characteristics for Level 1 and Level 3.
Default Texts:	Names used in the level 2 to identify operations.

5.4 GRAPHICAL CONFIGURATION:

This option is used to configure the different screens that will be viewed using the GE_POWER. Up to 16 screens can be defined. In each screen, the different objects that define and identify each device monitored in the substation are associated with their corresponding fields in the database (we build the system as a puzzle). There are complete collections of graphical objects representing elements (Switches, Circuit Breakers, Device Status, etc.) that can be selected by the user according to the specific visualization requirements. Each graphical object has specific characteristics in order to allow a complete control of the substation. These characteristics are explained later in this manual.

5.5 TOOLS:

This option offers a set of tools that we can use during the Substation configuration process.
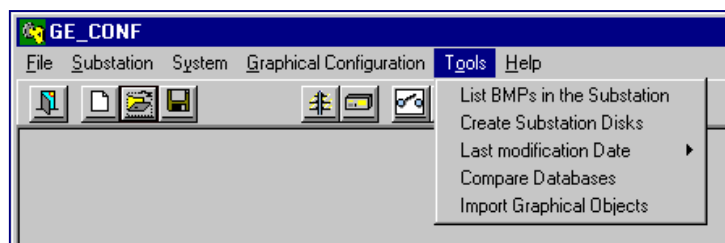
List BMPs in the Substation:	Display the list of BMP files used and the corresponding pictures, if desired.
Create Substation Disks:	Save on diskettes all the information used in the configuration process (.BMP files, relays and IED´s configuration and database files, Substation databases). This information can be downloaded to other computer.
Last modification date:	Displays the date when the last database modification was performed.
Compare databases:	Compare two databases and display on the screen the differences.
Import Graphical Objects:	With this option we can import Graphical objects from an existing database. This is useful for a new Substation database with similar characteristics to previous ones.

In the next chapters we will detail all the options explained before in order to have a complete understanding of the different possibilities of the GE_CONF.

6 FILE MENU

The first step after starting the GE_CONF will be to select whether we want to work with a new database or with an existing one. This selection is done in the **File** Menu *(clicking the corresponding option)*.
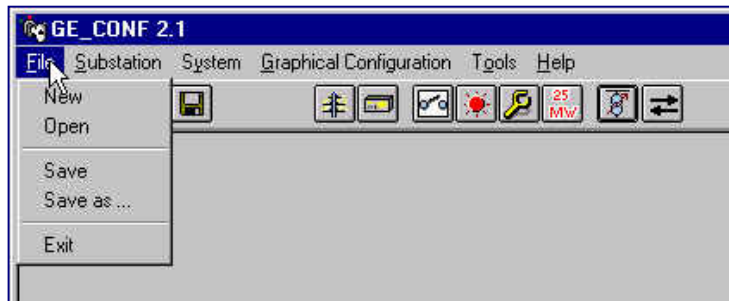
In case of choosing to work with an existing file (Option Open), a dialog box will appear. Using that dialog box the user can search and select the working file.

Save and **Save as**. Both options are enabled when a working file is open, no matter if it is a new file or an already existing file. With the first option, **Save**, we save the working file with the current name, and with the second option, **Save as**, we can save the working file with a different name.

The last option is **Exit**. When choosing this option with a working file open, the program will offer the user the opportunity to save the changes. If there is no file open, or there has not been any change on the file, GE-CONF will close.

7   SUBSTATION MENU

With the different options in this Menu, the user can configure the "GENERAL SUBSTATION TABLES" These tables are built from the level 1 units data collection. These tables are the basements to define the graphical configuration, as they include every element configured in the different units, identified and available for assigning the desired objects in the monitoring.
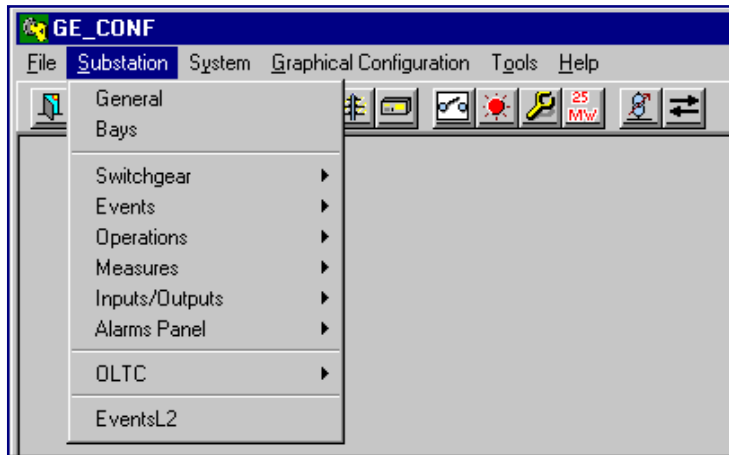
Besides, this Menu brings the possibility to configure all the signals that we want to send to the level 3 (SCADA), assigning the corresponding protocol numbers.

7.1 GENERAL

The option **General** allows to define the General characteristics in the Substation that we are configuring. The Dialog Box that is available to do these definitions is shown in the next page. The fields of this Dialog Box are as follows:

Substation: Here we fill the Name of the Substation.

Address: Address of the Concentrator in the Substation (level 2). We need this identification to allow level 3 to address its messages to the corresponding Substation, and therefore to integrate and manage several Substations in the Electrical System. The address must be a number between 0 and 254.

Comments: Any relevant comment we want to add. This field is optional. We do not need to fill it in. The text is used only as information.

To exit this Dialog Box, we click over the two options shown on the left side:

Cancel: The changes and the information of the Dialog Box are lost.

Accept: The changes and the information of the Dialog Box are saved. The fields Substation and Address are mandatory. If any of these fields is empty, a warning message will appear and we will not be able to exit the Dialog Box until completing correctly the two fields or clicking over the **Cancel** option.

7.2 BAYS

Using this screen, the user can configure the existing bays in the Substation. Through this option, the table BAYS is modified and additionally GE_CONF will build all the GENERAL SUBSTATION TABLES with the configuration of the bay that has been added, modified or deleted. As already mentioned, the Graphical Configuration of the System depends on the structure of these tables. Therefore, it is recommended that any action over these tables is carefully controlled.

This Dialog Box allows adding, modifying and deleting bays in the Substation. The list of available bays appears on the right side of the Dialog Box. Bays will appear with the name assigned on the left Dialog box.

ALPS bays can be added or deleted, but can not be modified.

7.2.1   ADD A BAY

To add a new bay, first click on the **New** button. After that we need to define the characteristics of this new bay:

Type: Type of device: DDS or ALPS. If the device is an ALPS type, we will need to define NumFaults (number of fault information that the relay will store). Once we have defined the type, we will not be able to change it.

Identification: Name of the bay: how it will appear in the GE_POWER software.

Configuration: For DDS family devices, this field refers to the Configuration File. This file needs to be previously created with the GE_INTRO software. From this configuration file, we know the device model. In the bottom right side of this text, there are other two texts that show the model database version used to generate the database and its name in the Substation. In case of ALPS relays, we will select the corresponding relay database.

Number: Unit number that identifies the device. This is a unique number for each device in the Substation, in order to differentiate it from other devices existing in the same Substation. In case this number is duplicated, assigning the same number of a different device, GE-CONF will show a Warning Message, as the communication between the CONCENTRATOR (level 2) and the level 1 would be incorrect.

Password: Assigned to the device.

Connection: The type of connection is defined here. Each connection corresponds to one of the ports in the PC. If we have a DDS family device, then we can communicate up to 24 DDS units through the same communications port (we will have up to 24 DDS modules with the same number associated to the connection). Relays type ALPS need a communication port per each module. In this last case, the program will associate consecutive numbers to the connection.

In order to achieve a correct performance, and to avoid conflicts in the System, the entered data must match the relay data.

Once we have entered all the necessary bay data, we add it to the rest of the Substation clicking over the **Accept** button. In this way, the bay is incorporated to the Substation. All its configured elements (events, measures, associated switchgear...) in the device database (corresponding to the specific model), and in the configuration file (file generated by GE_INTRO) will be added to the GENERAL SUBSTATION TABLES.

In the last step, GE_CONF will ask if the added bay has incorporated an On load tap changer (OLTC). If we answer yes, we will need to enter the corresponding data.

7.2.2   DELETE A BAY

To delete a configured bay, click on the bay that appears listed on the right side of the Dialog Box. After selecting the bay, we click on the button **Delete**.

Deleting a bay means eliminating it from the BAYS table and consequently causing the elimination in sequence of all its elements (Events, Measures, Switchgear associated...) from the GENERAL SYSTEM TABLES. Also all the Graphical Objects related to these elements will be deleted from the GRAPHICAL OBJECTS TABLE.

This option can only be applied in case of DDS family modules. This action permits, on one hand, to change some of the characteristics in the BAYS table, with no other additional implication. On the other hand, with this action we can rebuild the GENERAL SUBSTATION TABLES, as a result of modifying the configuration file of a bay.

In the first case (modifying some characteristics in the bay), we select the bay by clicking on the list shown on the right side of the Dialog Box. After that, we make the changes, and finally, clicking on the **Accept** button we update the information.

The second case, as mentioned above, allows to rebuild the associated information in the database, every time that the bay configuration file is modified. To do this, we select the new file and then click on the **Accept** button. If the new configuration file does not include all the elements configured before, they will be deleted from the Substation database. If there are elements that have been modified, they will also be modified in the Substation database. If there are new elements, they will be added to the Substation database. This affects also to all the Graphical Elements related to the existing elements in the bay. If any element was deleted, the corresponding objects will also be deleted. If any element was modified, the software will give the user the option to maintain or to eliminate the corresponding object.

Now, we will explain the Menu options that allow configuring the GENERAL TABLES, which contain the information collected from all the devices. These tables are generated from the previously configured BAYS table.

7.3 *SWITCHGEAR*

When selecting this option and after clicking on the desired bay, the dialog box shown below will appear. This dialog box allows to configure the SWITCHGEAR table.
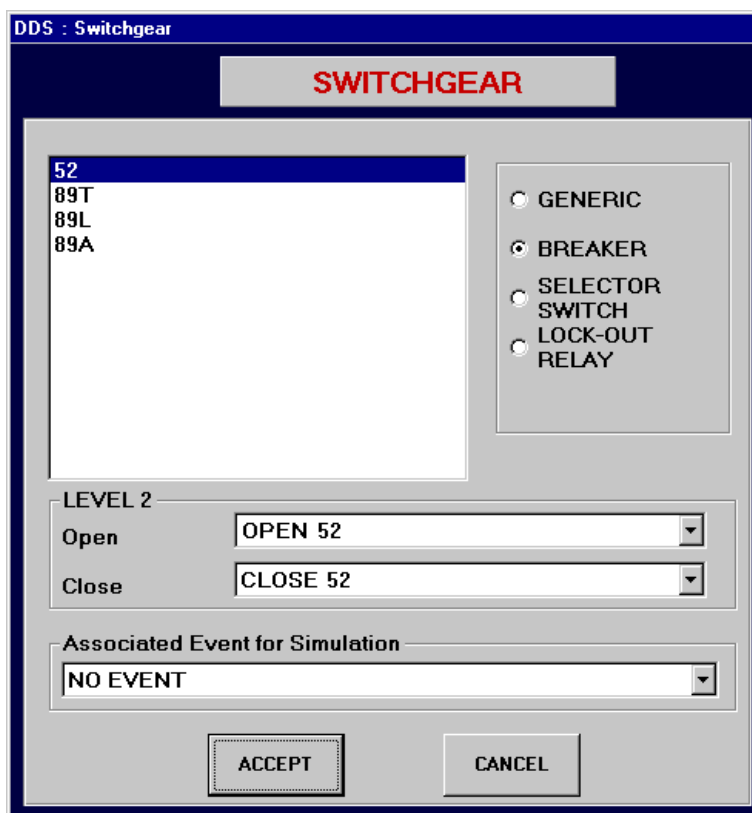
First, we need to indicate the **type of Switchgear**: GENERIC, CIRCUIT BREAKER, SWITCH or LATCHING ELEMENT. For this purpose, we click on one of the four options.

Then, the **Operations** corresponding to the Switchgear are selected. These will be selected from the whole of operations configured for the relay associated to the switchgear.

In case the CONCENTRATOR is in SIMULATION mode, we can configure an event that will appear when we perform a operation on the switchgear.

In case of a RECLOSER, we can only configure the Number and RTU group, because the rest of characteristics are already configured in the device.

To exit this Window, one of the following two options can be chosen:

Cancel: Exit without saving the changes.
Accept: Saving the changes, and then moving to the main window.

These two buttons will be available in all forms of this type.

7.3.2   ALPS

If the selected bay is an ALPS device, the dialog box is different. The list of switchgears is maintained and also the possible operations that we can select, but we find new elements such as the list of inputs from where we can select the one associated to each switchgear, and a text box where we can write the text associated with the selected switchgear.

7.4 EVENTS

When this option is selected, we enter to the Window that allows to configure the table of EVENTS. This table is built from the configured events in each bay defined in the Substation.

In case of a DDS Family device, the dialog box will look as follows.
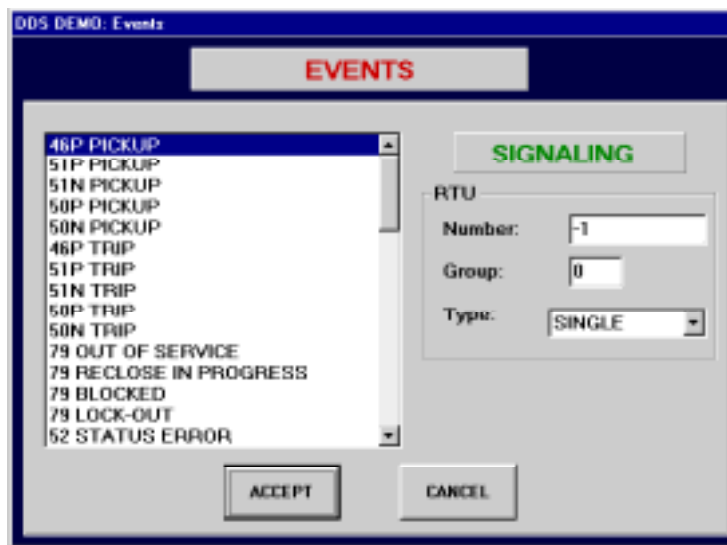
On the top of the Window we can find the list of the Substation bays. When selecting a bay, the list of events configured for that bay will appear on the grid below.

Two types of events can be defined: **SIGNALING** or **ALARM**. The main difference between them, from the level 2 (CONCENTRATOR) point of view, is that the SIGNALING will not appear on the alarm panel, but the ALARM will. For this reason, to the ALARM type events must be assigned a **Priority**. This is a number between 1 and 4. Number 1 indicates the maximum priority and number 4 the minimum.

The characteristics for the RTU are as follows:

<u>**TYPE**</u>

Type of event for the RTU. It can be one of the following types: SINGLE EVENT, DOUBLE EVENT, and LOGICAL EVENT.

A SINGLE EVENT has only two possible statuses: ON, OFF. We can call them normal events.

A DOUBLE EVENT has four possible status: ON, OFF, UNCERTAIN and ERROR. This double event is composed by four level 1 SINGLE EVENTS. These four events must be consecutive and they have the same RTU identification and RTU group number. The reason for this is the fact that for the RTU there is only one event.

A LOGICAL EVENT is a SINGLE EVENT that can be transmitted to the level 3 (SCADA) or not, depending on whether the event has RTU number. This event is used as part of a Logical event in the level 2 (L2 Events). This type of events will be explained later on.

<u>**RTU Number**</u>

Identification number associated to the event for RTU.

<u>**RTU Group**</u>

This is a group of signals of the same type as the event. The event will be transmitted to the RTU in its group.

<u>**ALPS**</u>

In case of an ALPS relay, the dialog box is similar with the list of the events of the bay and the RTU characteristics to define. Furthermore, for these relays we need to define the type of event (origin of the data that caused the event) to be selected among STATUS, MEASURE, INPUT, OUTPUT or NONE. As we select the origin, a list of elements (status, measures...) will appear, from where we will select the one that caused the event.

7.5 OPERATIONS

In this point we configure the table of OPERATIONS, that is generated from the operations defined in each device defined in the Substation.
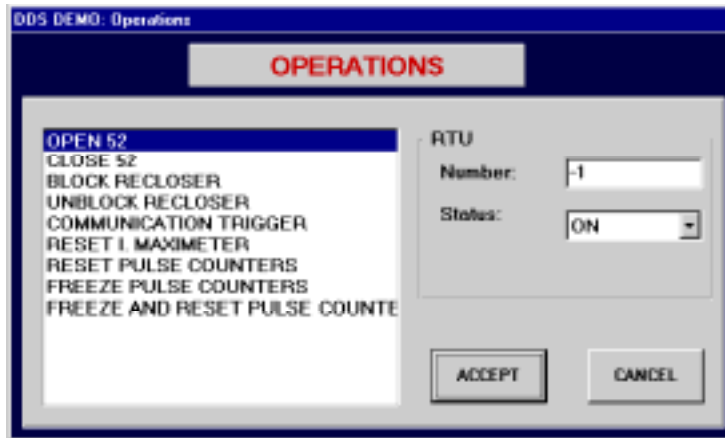
When clicking this option, the window shown above will appear. Here we can select the bay and the list of operations associated to it. For each operation we must selet ints characteristics in relation to the RTU:

RTU Number: Identification of the operation in the RTU. This is the number that will be transmitted in the corresponding message when the level 3 orders the operation.

Status: We can select ON or OFF. This definition is necessary for the RTU communication protocol, in order to send the operation from the level 3.

We need to define the Number and the Status for the RTU in order to identify the operation in the level 3-communication protocol.

7.6 MEASURES

This option is used for configuring the MEASURES table. This table is generated from the database of each device defined in the Substation. When we click on this option, the following Dialog Box will appear:
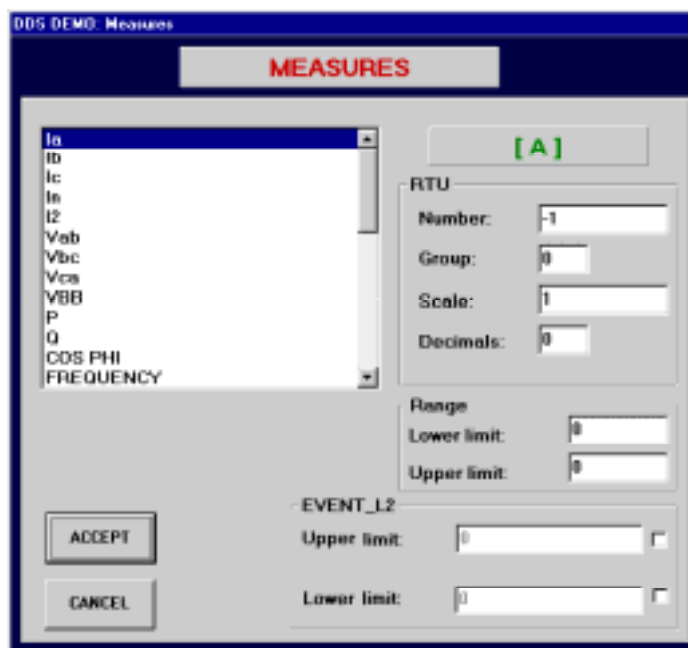
When selecting a BAY from the list, all the associated measures will be displayed.

7.6.1 DDS FAMILY

In case of a DDS Family bay, the measures can be of different types (the type can not be modified, because it is defined in the level 1): NORMAL MEASURES (we define as normal measures the ones collected from the CT´s and PT´s without the use of any transducer), ANALOG MEASURES (they are measures collected through external transducers), COUNTERS and PULSE_COUNTER. Depending on the type of measure, the characteristics are as follows:

NORMAL MEASURES: They are received from the level 1 in engineering units, e.g. voltages, currents.

ANALOG MEASURES: They reach the level 2 as they where collected from the analog input boards installed in the level 1 devices. These measures need a scale factor in order to obtain the corresponding engineering value, e.g. Active Power, Reactive Power.

COUNTERS: Values that are normally increased, e.g. Numbers of openings, number of reclosures.

PULSE_COUNTER: Some digital inputs in the level 1 devices can be defined as pulse inputs. The level 1 device counts the number of pulses that arrive to this input and apply a scale factor to convert this number to engineering units. Then, this value is sent to the level 2 (CONCENTRATOR).

In case of NORMAL MEASURES and PULSE_COUNTER types, the units are read from the device (level 1) configuration file. They appear in one box of the Window delimited by brackets.

In case of the ANALOG MEASURES or PULSE_COUNTER, it is possible to define the associated text, by double clicking on the specific measure in the Dialog Box. Units are defined in the same way, because for this type of measures, the device does not know the units.

Independently from the type of measure, we can configure the characteristics for the level 2 and for the RTU protocol.

Upper Limit and Lower Limit: They are the maximum and minimum allowed values for a specific measure. The level 2 (CONCENTRATOR) will use them to send the adequate measured value to the level 3.

Number: Identification of the measure for the RTU.

Group: Group number where the measure is. The measure will be sent to the level 3 as part of this Group.

Scale: Scale factor that must be applied in the measure in order to make a units change and so to prepare the measure to be sent to the level 3.

Decimal Places: Number of Decimal places expected by the level 3 for the measure.

The treatment of all this data will depend on the communication protocol used in the level 3. There are communication protocols as the INDACTIC, where the measures are transmitted in counters and in 12 bits. Other communication protocols, as the IEC_870_5_101 require the use of Integer values to transmit the measures. The different fields will be configured depending on these characteristics. Let us see some examples:

a) **Transmit a measure to the level 3 performing a change of units and with Integer format**: For example, we need to transmit the value of 105,3 V and the level 3 expects a measure with 2 decimal places and with units in kV (the scale factor will be 1000 to change the units from V to kV):

> Because of the scale factor, we need to divide the value 105,3/1000 = 0,1053.
>
> Because of the 2 decimal places expected by Level 3, we need to multiply the previous value by 100: 0,1053 x 100 = 10,53.
>
> The Integer part of this value is transmitted, that means 10.

b) **Change an Analog measure (12 bit) to engineering units (V, kV,...):**

> Measured value = 12-bit value x factor
>
> Factor = (Upper limit - Lower limit)/(4096-1)

Sometimes it is necessary to transmit all the measures in 12 bits and as a number of pulses. For these cases, we need to do an inverse counter in the NORMAL MEASURES. This is the reason why the limits are defined.

d) **Transmit the pulse counters in number of pulses instead of energy units**: For PULSE_COUNTERS, and only in case the level 3 communication protocol has this requirement, we need to configure the **Factor** value. This is the divisor number to correct the value that arrives from the device (energy value) in order to convert it to a number of pulses calculated by the device.

This dialog box permits also to decide if a L2 event type related with the measure (when the measure exceeds a maximum or a minimum value) needs to be activated.

7.6.2   ALPS

In case of an ALPS relay (where the measures will be ANALOG or PULSE_COUNTER type) we must only configure the RTU characteristics and the L2 events.

7.7 INPUTS/OUTPUTS

The INPUTS_OUTPUS table must be configured. This table is generated from the level 1 (device) database in the Substation.
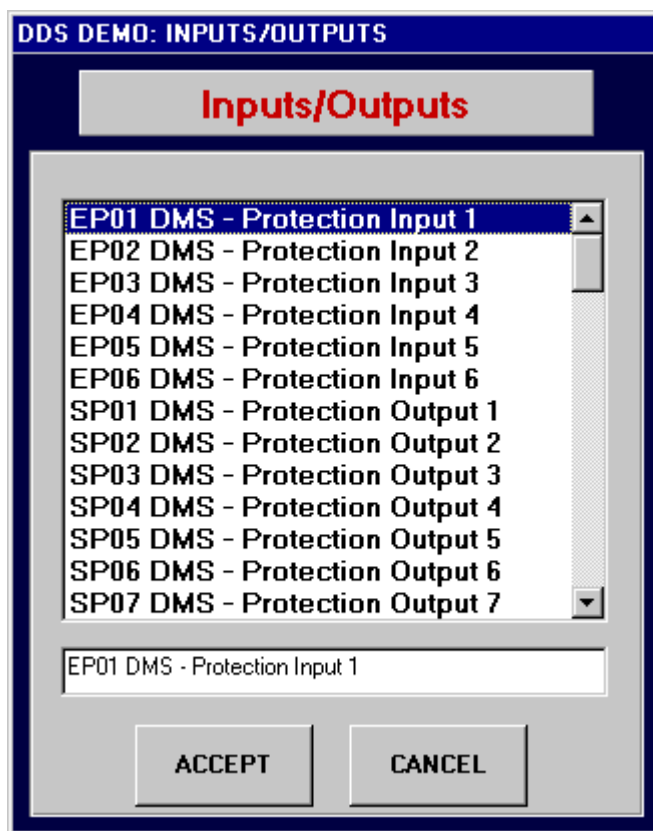
In this case we only need to define the text that will appear in the level 2 (CONCENTRATOR). This is applicable for both, DDS family and ALPS units.

7.8 ON LOAD TAP CHANGER (OLTC)

In this Dialog Box we configure the characteristics of OLTCs in the Substation. It is only possible to define an OLTC in DDS family models.

In the **Bays** screen, each time that we click on the button **Accept**, a Message Box appears asking whether the bay has an associated OLTC or not. We will only be able to configure the OLTC´s for those bays where we answered **YES**. If we find that the bay has an OLTC, but previously we did not define its existence, we will need to follow these steps:
Exit the Dialog Box, click on the **BAYS** option of the Substation Menu, and click on the bay where we want to add the OLTC. We need to ensure that we have the right configuration file, and finally we click on the button **Accept**. Now when the Message box asks if the bay has OLTC we will answer **yes**. Finally, we can return to the OLTC Dialog Box.

To eliminate an OLTC we follow a similar process as the one described above. In this case we will answer **No** when the Message Box asks whether the bay includes an OLTC.

As in the rest of Dialog Boxes, we select the OLTC, and then we can start with the configuration of the remaining characteristics.

For the RTU:

Group: Group number where the OLTC belongs. Level 3 must request this group in order to know the TAP position.

Operation number: Operation number (in level 3) to identify the corresponding tap increases or decreases.

Alarm number: Identification number (for level 3) of the event generated each time that the OLTC changes the TAP.

For Level 2:

Minimum TAP: Minimum TAP value. When the TAP is in this position, the order to lower the TAP will not progress

Maximum Tap: Maximum TAP value. When the TAP is in this position, the order to increase the TAP will not progress

Timeout (in seconds): Maximum time between the operation to raise or lower the TAP and the response received from the OLTC. If during that time the TAP does not change, a level 2 event is generated.

Raise Tap Operation: Selection of the Increase TAP operation. The operations that we can select are the ones defined in the device by means of GE_INTRO software. No other operations will be available.

Lower Tap Operation: Selection of the Lower TAP operation.

7.9 L2 EVENTS

Level 2 Events are generated by the GE_POWER, and therefore they do not come from the level 1 devices.

We can find 5 groups:

- Communications Failure from any Substation bay
- Failure to change the OLTC.
- Change Operation Mode
- Alarms logic.
- Measures events
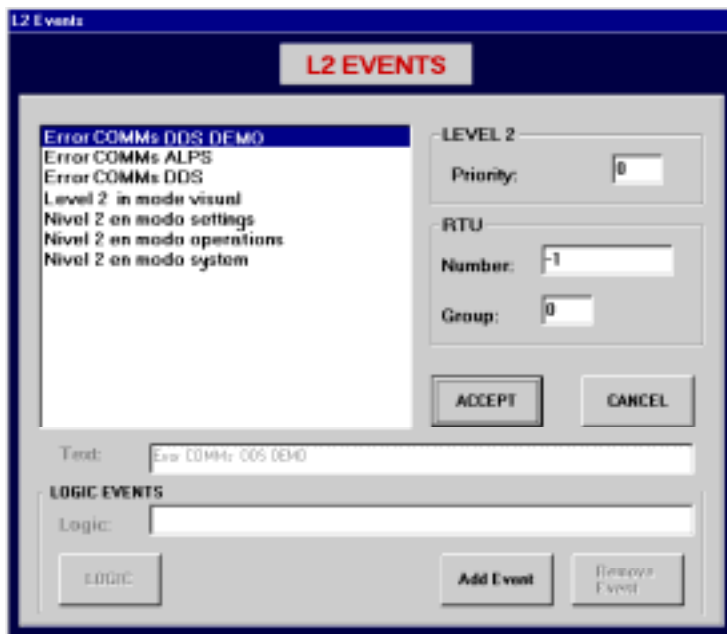
In the list shown on the left side of the Dialog Box, there is a Listing of the Level 2 events in the Substation. 30 events are booked for COMMUNICATIONS FAILURE in the Substation bays. If there are 10 bays, there will be 10 COMMUNICATIONS FAILURE events and the remaining 20 will not be operative. The next 10 events are reserved for OLTC TIMEOUTS; the next 10 for ACCESS LEVEL CHANGES and finally, the remaining events are LOGIC EVENTS.

For Level 2 requirements, the **Priority** must be configured: This will be a number between 1 to 4. 1 meaning maximum priority event, and 4 a minimum priority event.

As for the RTU requirements, the following characteristics must be defined:

RTU number: Identification number for the event in the RTU.

RTU Group: Same group of signals where the events is. The event will be transmitted to the RTU in this group of signals.

The Dialog Box includes two buttons: **Add Event** and **Remove Event**. Both refer to LOGIC EVENTS type. For this type of events, additionally we must define the **Logic** and **Text fields**. A LOGIC EVENT will be an equation with logic AND, OR and NOT operators over other events. The field **Logic** contains the equation. Different events can be related through logic operators. The result of the global equation will be a Level 2 LOGIC EVENT.

The field **Logic** can be completed from the keyboard in the corresponding text box, or clicking on the **Logic** button, in order to use a tool where the user can formulate it in a more mechanical way.

Text can also be configured for events type measure.

8   SYSTEM MENU

With the options in this Menu we can finish the configuration of the GENERAL SYSTEM TABLES. These tables contain information that will be used by GE_POWER.
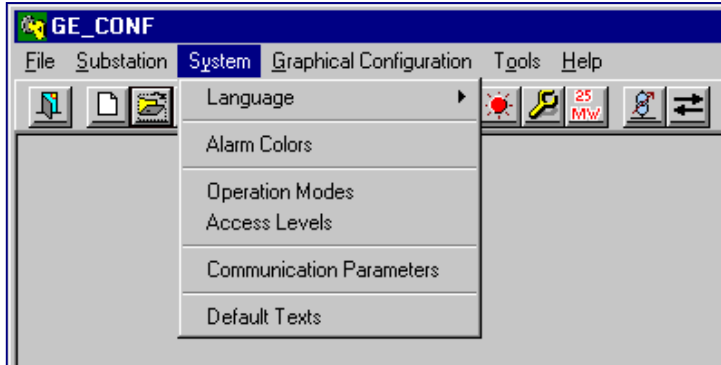
This menu provides General Information about the System, e.g. the language used, the colors, etc.

In the following sections we will see more in detail the different options in the Menu.

8.1 LANGUAGE

With this option, we can select the Language for the GE_CONF. Nowadays the following languages are available: Spanish, English, French, Portuguese, German and Italian.

We need to remark that the texts in the DEFAULT_TEXTS table that will be used for the different Access levels and as text for Operations in the GE_POWER, must be defined in the same language that will be used by the GE_POWER. Otherwise GE-POWER will not recognize them.

8.2 ALARM COLORS

With this option, we can select the colors for the Alarms, and we can configure the BEEP signal to indicate new alarms.

The Dialog Box shows two different areas to be configured: At the top, the **STATUS** related area, and at the bottom the **FOLDER TABS** related area.
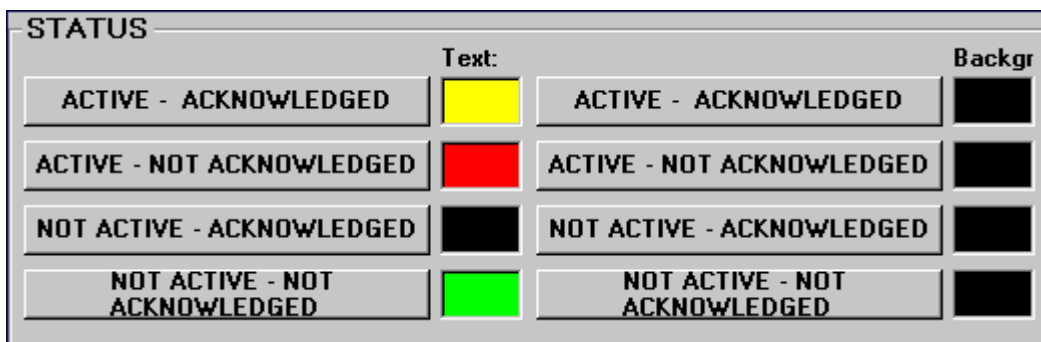
Alarms can be in ACTIVE or NOT ACTIVE status. Depending on whether they where acknowledged or not, they will be ACKNOWLEDGED or NOT ACKNOWLEDGED. The combination of these both single status gives us 4 different status for the alarms in a certain moment. With this information we select the color that will represent the Alarm depending on its status.

In order to select a color, we click on that button showing the alarm status that we want to configure. A color palette will be displayed. We choose the color and then click on the Accept button.

The NOT ACTIVE and NOT ACKNOWLEDGED alarm will not be displayed on the panel. Therefore, the GE_POWER will not take into account the color selected for this status. This option is maintained for future applications.

8.2.2   FOLDER TAB

GE_POWER incorporates a group of Folders (up to 16). Each Folder can be related to one or more bays. The configuration of this "folder-bay" relationship will be explained later in this manual, when we describe the Folder Graphical Configuration. The purpose of this option is to change the color of a folder tab in case there is an active alarm in one of its related bays. E.g. If Folder 1 is related to bays 3 and 4, and there isn't any active alarm from any of these two bays, folder 1 tab will be displayed with the configured **background** color for NO ALARMS status. If there is an alarm in any of the two bays, the folder tab will change its color to the color defined for the alarm with the top priority. If there are several alarms with top priority and other ones with less priority, the tab will be displayed in the color defined for the top priority alarms, in this case, red.
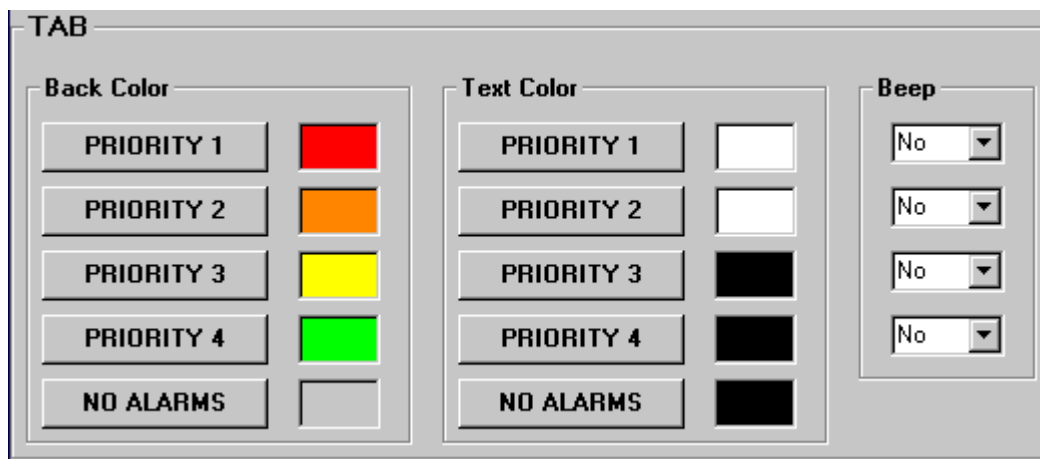
In the same way, we can configure the **Text Color** for the tab.

It is also possible to configure if we want a beep signal in the GE_POWER whenever a new alarm appears. This is configured by selecting Yes or Not in the **Beep** option shown on the right side of the Dialog Box.

8.3 OPERATION MODES

There are four different Operation Modes: **VIEW, OPERATIONS, SETTINGS** and **SYSTEM**. It is possible to configure the functions we want to be active for each operation mode. Clicking on the corresponding cell of the Dialog box, we can add or delete functions for each operation mode.

The available functions are shown below. They are View, Acknowledgement Alarms, View Settings, Modify Settings, Operations, Modify Access and Exit.

The Operation modes are the basement to configure the Access levels that will give the System the possibility to control which functions can be accessed by each user in the GE_POWER.

SYSTEM OPERATION MODES

	View	Acknowledge	View Settings	Modify Settings	Perform Operation	Modify Access	Exit Program
VIEW	X						
OPERATIONS	X	X			X		
SETTINGS	X		X	X			
SYSTEM	X	X	X	X	X	X	X

ACCEPT   CANCEL

In the previous picture we can see a common configuration for the Operation Modes.

- In the **VIEW MODE** option (lowest mode), we can only view the elements of the System. There is no permission to activate the rest of basic functions.

- In the **OPERATIONS** mode, we can view the System, acknowledge Alarms, and make Operations.

- In the **SETTIGNS** mode, we can view the system and acknowledge Alarms. Additionally, we can enable the functions related to settings: view and modify settings.

- Finally, in the **SYSTEM** mode (only allowed to the Superuser of the System) we can perform all the basic functions. It is only possible in this mode to modify the Access permissions in the System, creating new users with the corresponding Access levels and associated Password.

- This is also the only mode in which it is possible to Exit the GE_POWER.

8.4 ACCESS LEVELS

Up to 10 different Access levels can be configured for the GE_POWER. Each Access level will allow a combination of the previously defined Operating Modes. The process of configuring Access levels is similar to the configuration of Operating Modes. We need only to click the corresponding cells in the Dialog Box.
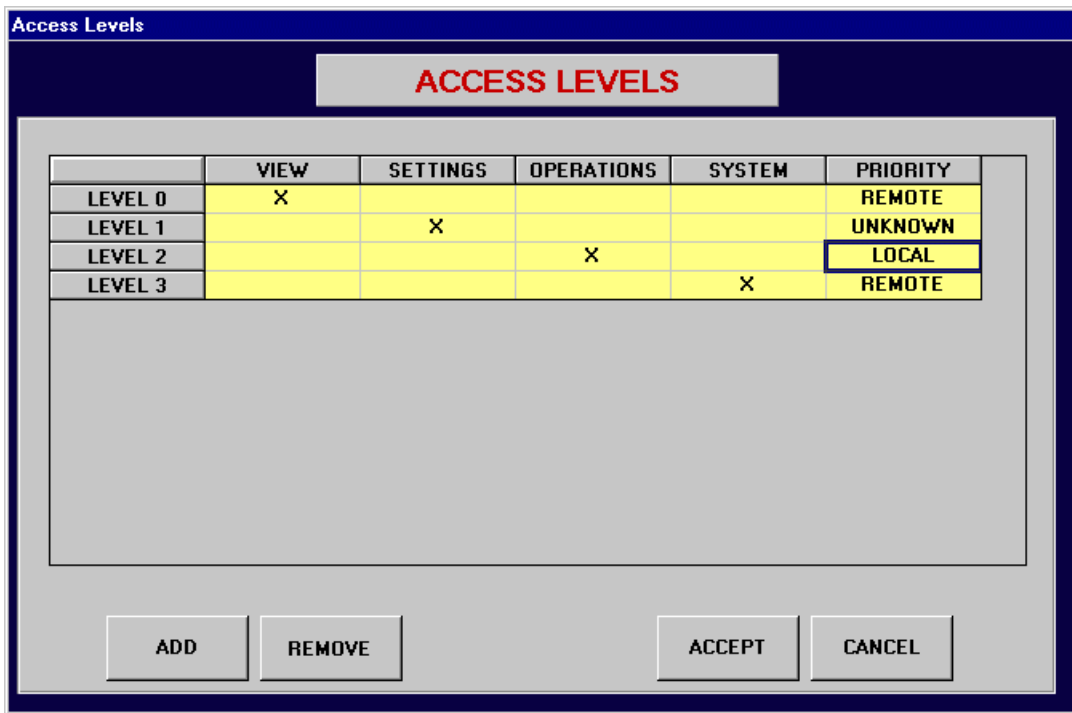
The default texts appearing for each level are Level 0, Level 1.... These texts can be changed clicking on the Text box. A Dialog Box will be displayed, where we can write the desired text. As explained during the execution of the program, this text will appear on the bottom right side of the GE_POWER screen, indicating in every moment which Access level is allowed for the current user.

The **PRIORITY** column shows three possible values: LOCAL, REMOTE or UNKNOWN. These values are used by level 2 (CONCENTRATOR) to differentiate the priority to perform operations: Level 3 (RTU), or level 2 (GE_POWER). If the field is set to "REMOTE", level 3 can perform operations. Otherwise, level 3 will only be able to view the information, and level 2 will control the settings and operations.

The buttons labeled **ADD** and **REMOVE** are used to add new access levels to the existing ones, and to eliminate the last configured access level.

It is important to know that the GE_POWER always starts with the access **level 0**. If this level is configured only for VIEWING information, we will ensure that only the **VIEW** mode will be allowed.

If another user pretends to perform any other function, he must reach his corresponding Access level by entering his name and password.

Taking into account the different Access Levels defined here, we can enter the different users in GE-POWER, each with his/her own access level. This features gives the system great flexibility, as only the appropriate users can access the desired functions.

8.5 COMMUNICATION PARAMETERS

When choosing this option, a second menu is displayed. This new menu allows the user to select the type of connection (RTU1, RTU2, FAC1 to FACn, ALPS1 to ALPSn) for which we want to configure the communication parameters.

The parameters to be defined can be selected by clicking on the appropriate option:

Port: Can be selected from Port 1 to Port 20.

Baudrate: It is possible to configure any standard speed communication rate between 9600 to 115,000 baud.

Bits   per character: 5, 6, 7 or 8 bits per character.

Parity: The parity for the communication can be selected (Odd, Even or no parity).

Stop bits: We can select the stop bits used in the communication.

The above mentioned parameters can be configured for RTU or Level 1 communication. Hereafter we will detail those parameters that are different for each type of communication.

For **RTU communication,** we need to define also the type of **Connection**: The connection type is selected from the following options: SERIAL (for the communication using a serial interface through the communication ports available in the PC), or RADIOMODEM (when the communication with the RTU is made using a RadioModem link).

During the RTU configuration process, a Message Box with the question **"Enable the RTU Communication?"** will appear. If the answer is **Yes**, the communication parameters are configured normally. If the answer is **No**,

the communication with the RTU is disabled. In other words, the CONCENTRATOR will not implement this communication function towards level 3.

For the communication with **level 1**, we need to define the **Cycle Check Minutes** parameter. This setting is used by the CONCENTRATOR. Every certain period (the minutes defined here) the CONCENTRATOR activates a polling of the bays defined in the BAYS table. From this moment and until the next polling, the CONCENTRATOR only will ask the bays that responded during the polling. This is an interesting feature, as If during a certain period there are bays with disabled communication (for maintenance purposes, for example), the communication with Level 1 would be considerably slow because of communication TimeOuts. Checking through the CONCENTRATOR which bays are active, we optimize the overall time response of the system.

8.6 DEFAULT TEXTS

This Dialog Box allows to define the texts for the DEFAULT_TEXTS table, which will be used for operations. These texts will be used by GE_POWER whenever there is an attempt for a Switchgear or Recloser operation. This way, if the text is suitable, the user can know which operation is being carried out. The correspondence between Operation Texts and Default texts will be performed during the Graphical Configuration, with the corresponding Switchgear and Recloser objects.

We must take into account that we can only change the texts for the selected language.

9   *GRAPHICAL CONFIGURATION MENU*

Using this option, the user can build a customized interface to monitor all the components of the Substation: The Graphical Configuration consists on locating, in the different layouts or folders, several objects associated to the elements of the GENERAL TABLES.
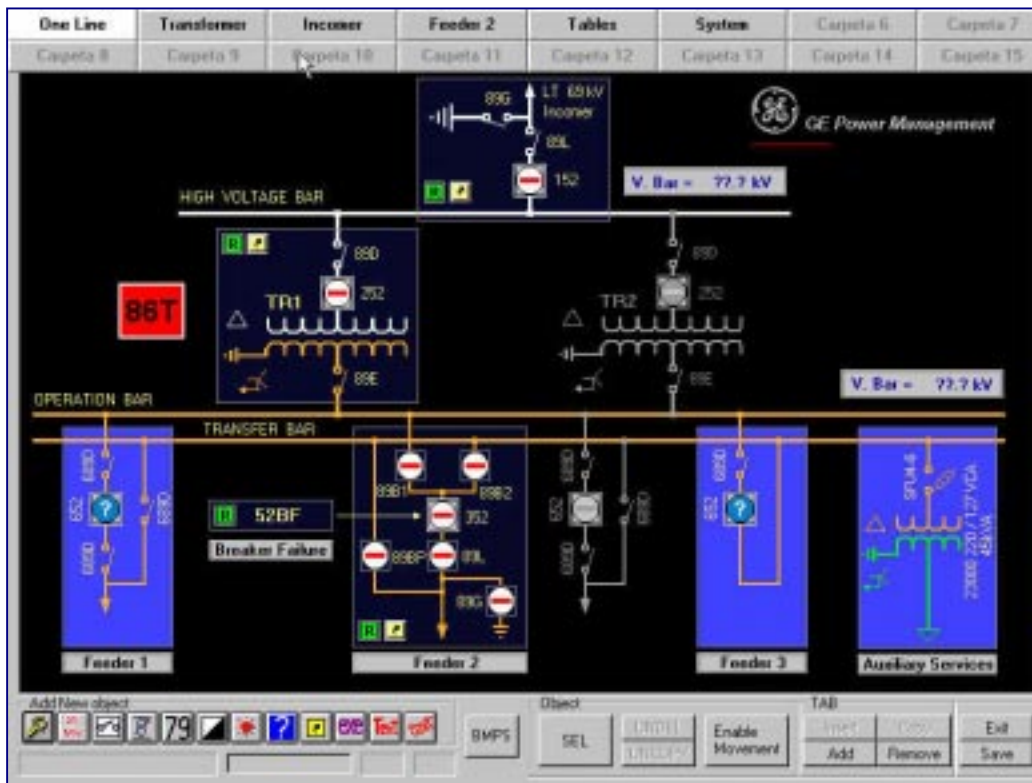
The user will place in the different folders, and according to the desired degree of detail, the available Graphical Objects, associating them to the different bays.

The objects (each object has unique characteristics) will respond according to the information arriving from the level 1 devices, monitoring the whole Substation.

The different objects can be represented either by texts or bitmaps, associated to the different states of each element. In order to achieve this, whenever a new object is added, GE_CONF will request all the BMP files associated to each possible state of the object. GE_CONF offers tools to view and associate BMP files, in order to make it easier for the user to work with them.

At the present time, a collection of libraries including the most common BMP pictures associated with devices in a Substation is available. These libraries can be supplied together with the GE_CONF. This feature provides the system with great flexibility, as the possibilities of customization for screens to be displayed by GE_POWER is unlimited.

The Graphical Configuration screen is divided in several sections:

- On the top of the screen, we can find the tabs for the 16 screens that can be configured.

- On the bottom, there are three groups of buttons. On the left side we find the buttons used to incorporate new objects. There are 10 types of objects. Some of them must be associated with a level 1 device (such as a Recloser), and others do not need to be associated (as the object GOTO). In the following list, we mention the different types of existing objects, which will described in detail later in this manual.

List of objects:
Operation, Measure, Switchgear, OLTC, Recloser, Latching, Active, Goto, Program and Text.

- On the bottom right side of the Window, we find a group of buttons that are used for General Purpose. They are the shown on the following Dialog Box.

- The other button on the bottom side (showing the text BMPs) allows to view the BMP files in the path defined in the conf.ini file. If a **BMP_Browser** has been configured in the same file, it will run when clicking on this button.
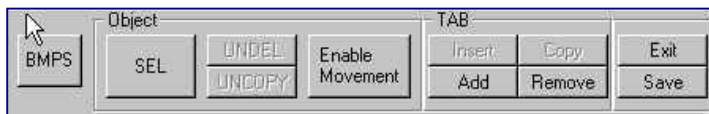
- Additionally, on the bottom area there are other elements: One of them shows whether the operation mode is Objects Placement. This is an indication to know if the option to Select Objects is enabled. The other one is an indication of the percentage of an operation that takes longer time.

9.1 FOLDER TABS

On the top of the Window, we find the tabs for the 16 configurable folders. The active folders will only be those folders configured in the actual Substation. The text is the name defined for the specific folder. The same text will be used by the GE_POWER.

The tab corresponding to the folder that is active in a certain moment is shown in a different color. If we want to switch from one folder to another folder, we just need to click on the corresponding tab. If the folder has already been configured, it will turn active. If not, the current folder will remain active.

If we double click on one of these tabs, the **Folder Data** Dialog Box will be displayed. In this Dialog Box we can define the Folder **Name**, the **Background color**, and the **Background picture** (if it is available). The changes will be updated when we exit the Dialog Box.

With this option we can also select the bays related with this folder, that is, the active bays that the GE_POWER will manage. This is necessary for the tabs to change colour in case of alarm existence in the related bays, according to the configuration of section 6.2. **System Colours.**

In case a BMP files editor has been set in the conf.ini file, two more buttons will became active: The first one is **Modify BMP** (this button runs the configured BMP files editor), and the second one, **Update BMP** updates the BMP file with the modifications made from the editor.

9.2 ADD NEW OBJECTS

To add new objects in the folders, there are ten available buttons. One button for each type of existing object, on the bottom left side of the Window.

To create a new object, it is necessary to have at least one Window configured. We click on the button, and the mouse shows a different icon (arrow + ?). We click with the mouse on the bay where we want to add the object. The object dialog box will be displayed. Here, we select the characteristics of this new object and then press ACCEPT.

The ten types of objects available are: Operation, Measure, Switchgear, OLTC, Recloser, Latching, Alarm, Active, Goto, Program, Text, and textrot.

A description of each object follows.

9.2.1 OPERATION OBJECT

The operation objects are used perform the operations configured at level 1 (for **DDS** and **ALPS**) that we want to incorporate to level 2. An Operation object is a button that can contain either a BMP file or a Text. All these characteristics can be configured in the Dialog Box OPERATIONS GRAPHIC. This Dialog Box is activated when we generate a new Operation Object, as well as when modifying an existing one.
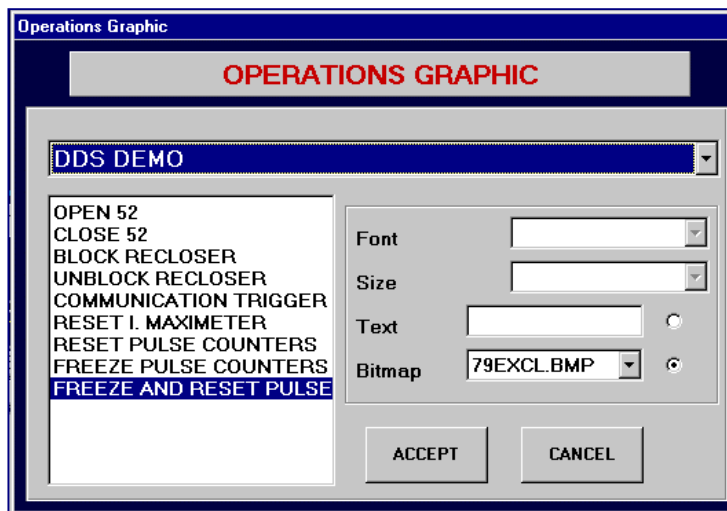
In the OPERATIONS GRAPHIC Dialog Box we can select the bay or the device related to the OPERATION object, and inside this bay, the concrete Operation. The bay is selected from the displayed list at the top of the Dialog Box. Under this list we find the list of operations that can be associated to the selected device, from where we can select one.

As already explained, an Operation object can be represented by a Text or a BMP file. We can select our preferred option in this dialog box. If we want to define a Text, we write the text in the box. Besides, we can select the font and the size used. If the option Picture is selected, we choose one of the BMP files that are available in the displayed list. These BMP files are in the configured path in the file conf.ini.

After configuring an Operation object in any of the Substation folders, the user can send a operation for this operation to the associated equipment by simply clicking on it.

The user can change the size of the OPERATION Object if it is represented by a text tab, by clicking on the Outside border that will appear if we click on the object.

When using a BMP file, the size of the button will depend on the original picture.

A measure object can be assigned to any measure configured in any level 1 device (**DDS** or **ALPS)**. This is a text that represents (when GE_POWER is running) the actual value of the corresponding measure. The different characteristics of this object can be configured in the MEASURES GRAPHIC Dialog Box. This Dialog Box is activated when the introduce a new Measure object, or when we want to modify an existing one.

On the MEASURES GRAPHIC Dialog Box, we can select from the list at the top, which bay or device we want to relate the measure to. Then, we can select the measure from the list on the left side. The units of the selected measure are shown in brackets on the right side of the Dialog Box. This is a complementary information for the user.
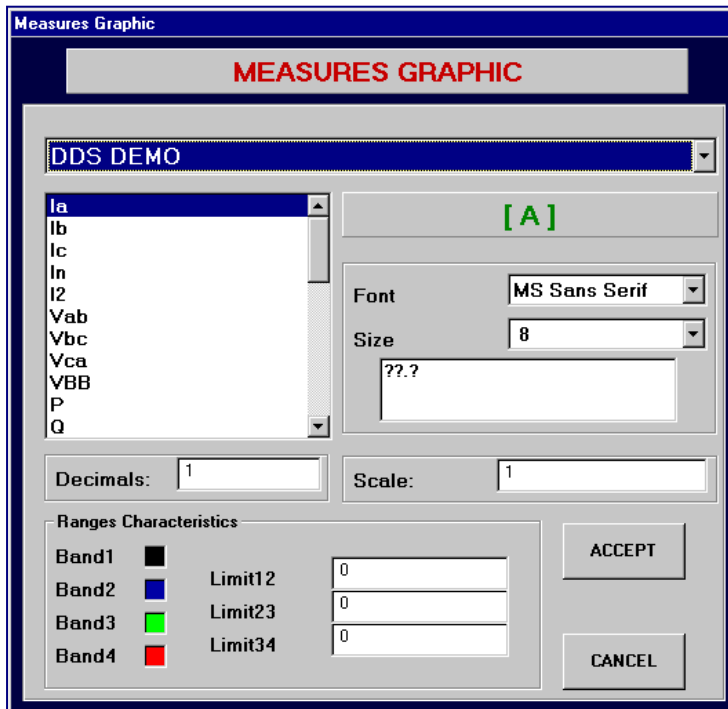
As it is a text, we must configure its **font** and **size**. We can do so selecting them from the lists shown on the screen. During the configuration process with the GE_CONF, the text shown on the display is **"????".** To modify this text in order to set the measure on the screen, we must modify it in the box where the "????" symbols are. In this case the size of the Object Measure will depend on the size of the selected font.

It is necessary to define the number of **Decimal** digits for the measure (0 by default), and the **Scale_Value** that we want to apply, if any, before the measure can be displayed on the GE_POWER screen.

Finally, we must define the characteristics for the different threshold bands for the measures. Up to four thresholds bands can be defined for each measure. Each threshold band has an upper limit. When this limit is exceeded, it will go to the immediate higher threshold band. These limit values can be defined here, as well as the color of the measure object as it will be displayed by GE_POWER depending on which threshold band it is in each time.

9.2.3   SWITCHGEAR OBJECT

A Switchgear Object is used to represent on GE_POWER the switchgear configured in a level 1 equipment. The switchgear can be of different types according to their characteristics: GENERIC, LATCHING, SWITCH, BREAKER and RECLOSER. The RECLOSER switchgears are associated to RECLOSER Objects (they present 7 possible status instead of 5 status of the Switchgear Object) and the remaining ones are associated to Switchgear Objects.

These objects will be displayed as BMP files, each of them associated to a different status. Every time a switchgear changes its status, the BMP file will change accordingly.

The characteristics of this object will be defined in the GRAPHIC MEASURES Dialog Box. Firstly, we will select the bay and the switchgear we want to represent with the object.

The following form will be displayed:

Although the association with Level 1 operations is performed in the SWITCHGEAR table, inside the GENERAL SYSTEM TABLES, every time we create a Switchgear object, it is possible to choose whether the GE-POWER user will be able to perform operations through this object, or whether it will only show the status. In this screen we can select if operations are allowed on this Switchgear or not, choosing between **Operational** or **Not Operational**.

We can also configure the TEXTS associated to operations in a Switchgear, which will be displayed by GE_POWER. We will be able to choose among the texts that were previously defined, in the *System Menu*, option *Default Texts* (section 8.6.)

There are 5 possible status for a DDS switchgear, as follows: **Open, Closed, Undefined, Error, and No Present**. For an ALPS switchgear the possible status are: **ON, OFF and Not present**. The switchgear will be in No Present status when the associated device or bay does not communicate, as in this case GE-POWER can not know its status. It is necessary to configure a BMP file associated to each different status, so that GE-POWER can display them.

For configuring the BMPs, we must place the cursor on the cell associated to the status we want to configure. The selected status will change colour. Then, we can choose a BMP file from the list.

It is mandatory to define the BMP file associated to each status. They do not need to be all different, it is possible to have the same BMP file associated to different status, but the GE_POWER user will receive more information if they are all different.

In this same form, we can modify the **SCALE** of the Switchgear object. This characteristic is associated to some GE-CONF objects. If the scale is 1, the BMP will be displayed with its original size. Otherwise, its size will be multiplied by the Scale value.

9.2.4   OLTC OBJECT

The OLTC Object can represent the TAP position of any OLTC in the Substation. It can only be defined for a DDS device. It is represented by a text in the GE_POWER. The text shows the TAP number of the associated OLTC. The different characteristics of this Object can be configured in the OLTC GRAPHIC Dialog Box. We can enter this option by clicking on the associated icon.

In the OLTC GRAPHIC Dialog Box we can select the level 1 bay or device where the OLTC is, as well as the OLTC itself. Then we must define the rest of characteristics of this Object. As it is a text, the remaining characteristics are the **Font**, the **Size** and the **Color**.
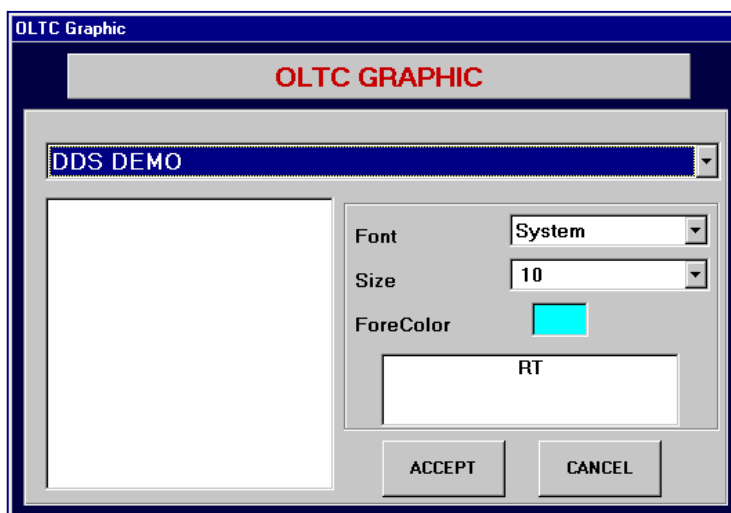
9.2.5   RECLOSER OBJECT

This Object is associated to a Recloser configured in a DDS family device. The definition process for this Object is similar to the one corresponding to a Switchgear Object. This object will be represented by different BMP files, associated to each possible status defined for the Recloser. Every time the recloser changes its status, the BMP file will change accordingly.

The characteristics for the Recloser Object are defined in the RECLOSER GRAPHIC Dialog Box (click on the icon). First we select the bay and the Recloser associated to the Recloser Object.
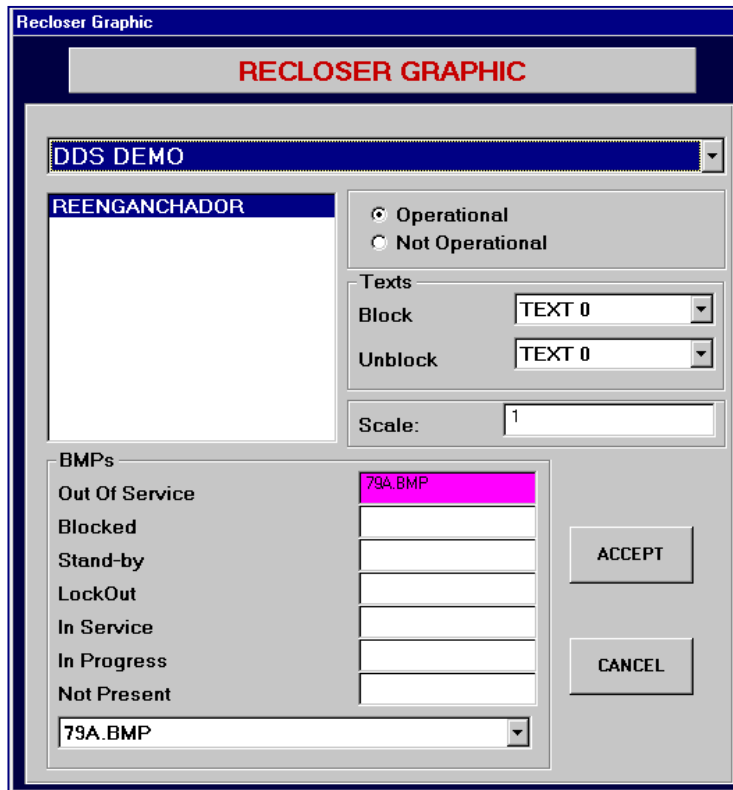
Here we can enable or disable the permission to perform operations on this Recloser from the GE_POWER. This is made selecting one of the two options: Operational or Not Operational. This option is equivalent to the one described for the Switchgear Object.

We can also define here the Texts associated to the Recloser operations, which will appear on GE-POWER. We will be able to select the texts among those previously defined in the *System Menu*, on the *Default Texts* option.

The seven possible Recloser statuses are **Out of Service, Blocked, Stand-by, LockOut, In service, In process, and No present**. The *No present* status is shown when there is no communication with the bay or device where the Recloser is. In this situation GE_POWER can not know in which status it is.

It is necessary to define a picture or BMP file associated to each status in order for the GE_POWER to show on the screen the corresponding picture depending on the Recloser status. The configuration of the pictures is made following the same process as we described in the Object Switchgear section. We place the cursor on the status we want to configure, and it will change its color. Then, we can select the associated BMP file from the list.

It is mandatory to define a BMP file for each Recloser status. The BMP files can be the same for one or more status.

Also it is possible to modify the Scale factor. This will be a number that will multiply the size of the picture associated. The restrictions described for the Switchgear Object are also applicable here.

9.2.6   BISTABLE OBJECT

   A Bistable (or latching) Object can be associated to each of the following level 1 elements: status, event or input/output in case of a DDS family device, and status or input/output in case of a relay model ALPS.

These objects will be displayed using different BMP files associated to each of the possible status for an Object of this type. When the Object modifies its status, the associated BMP file change to represent the new status.

The characteristics for this new Object are defined in the LATCHING GRAPHIC Dialog Box (click on the icon). Firstly we select the level 1 type of element (status, event or input/output). The bay and the element associated must also be selected.

The Latching Objects can show two possible statuses: **Active** and **Non Active**. The **No present** status is reserved for the lack of communication with the bay or level 1 device associated to the Object. The configuration for the associated picture is made as we described for the other Objects with associated BMP files. We will click on the box Status; the box will change the color. Then we select the BMP file from the list.

It is mandatory to define a BMP file for each status. The BMP files can be the same for one or more status.
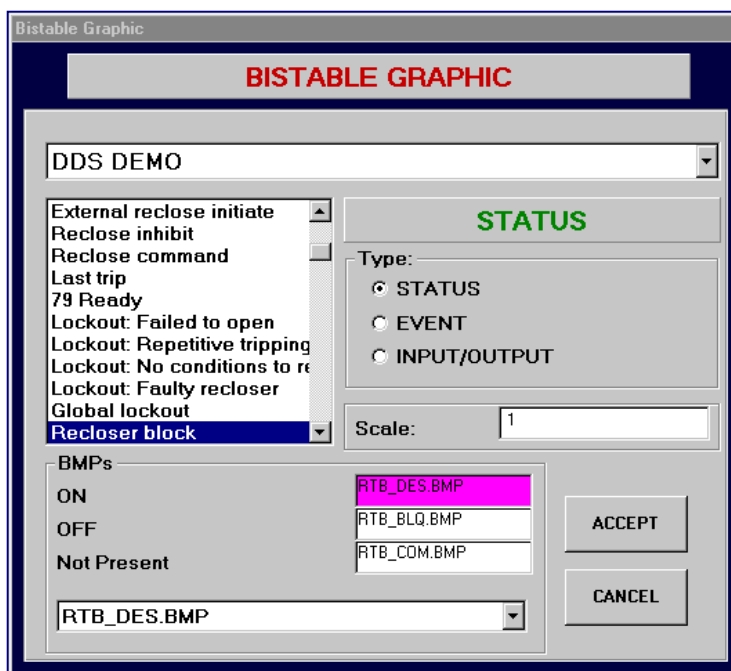
It is also possible to modify the Scale factor of the picture that will be shown on the screen. To do this we will follow the steps described for the Recloser or Switchgear Objects.

9.2.7   ALARM OBJECT

The Alarm object is used to indicate in any moment the current status of the alarms in the DDS and ALPS level 1 devices. The ALARM GRAPHIC Dialog Box allows to define the characteristics for this object.

The Alarm objects are represented by several .BMP files according to the different Alarm status. The possible status for an Alarm in the DDS case are: **ActiveNonAcknowledged, ActiveAcknowledged, NonActiveAcknowledged, NonActiveNonAcknowledged and NoPresence**. In case of the ALPS model the possible Alarm status are: **ON, OFF and NoPresence**. We can also define if the picture associated to the object remains blinking when the alarm is in some of these statuses.

9.2.8   PRESENCE OBJECT

The presence object is used to verify if a device in the Substation is communicating. Using the PRESENT GRAPHIC Dialog Box (clicking on the icon) we can define the characteristics for this object, as the associated bay.
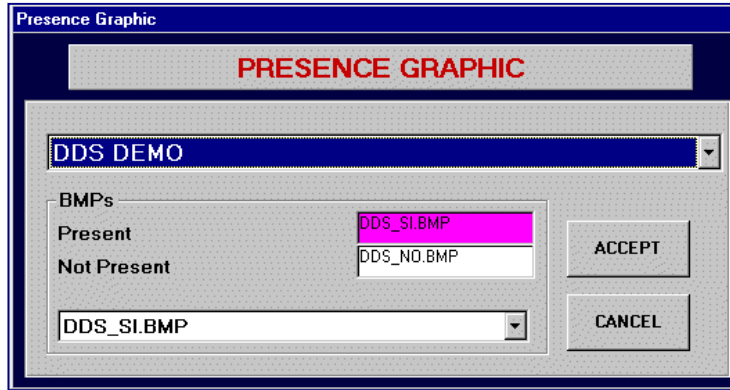
The presentation on the screen is made using BMP files. They will indicate if the communication is active (Present status) or if there is no communication (No Present status). The picture selection for each status is made following the process described in the previous items.

9.2.9   9.2.9 GOTO OBJECT

This Object is very useful during the GE_POWER operation. The characteristics are defined activating the GOTO GRAPHIC Dialog Box (icon).

Clicking on the GOTO object in the GE_POWER we go to the default folder. To configure the Default folder, we must select it from the available list. The list will include the already defined folders.

We need also to define the associated BMP file.
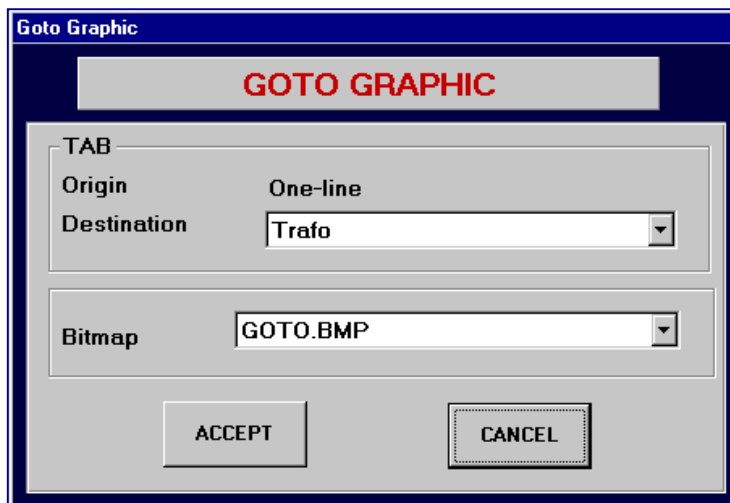
Using the Program Object we can run any program, associating a file if necessary. In the PROGRAM GRAPHIC Dialog Box we can define the different elements.

Clicking on the **Program** icon, we will go to the Dialog Box where we can select the program that we want to run. In the same way, in the box labeled as **Associated File**, we can define the working file associated to the executed program.
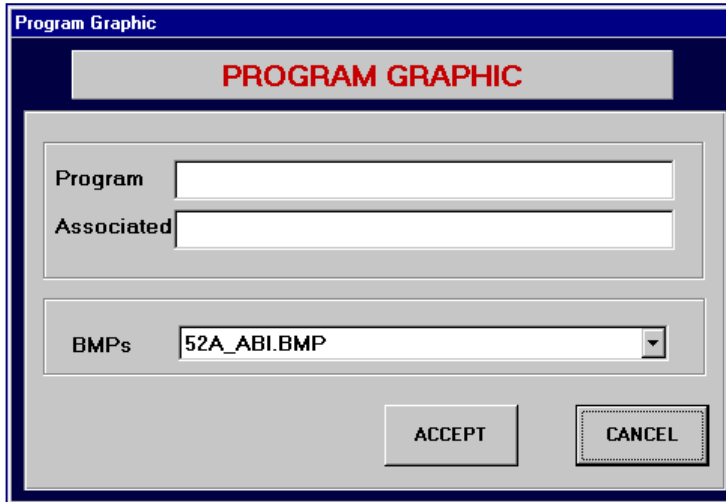
We also need to define the BMP associated to the Program button.

The Text Object, as its name indicates, is a Text that will be displayed on the GE_POWER with no possibilities of being changed. It is used only to show texts that can be important when we are viewing the folders in the GE_POWER. E.g. we can use it to name the measuring units.

In the Dialog Box of the GRAPHIC OBJECT_TEXT we can define characteristics such as **Font**, **Size**, **Color**, if we want the text in **bold** or **underlined**. Also there is a box where we can entered the **text** that will appear on the screen.
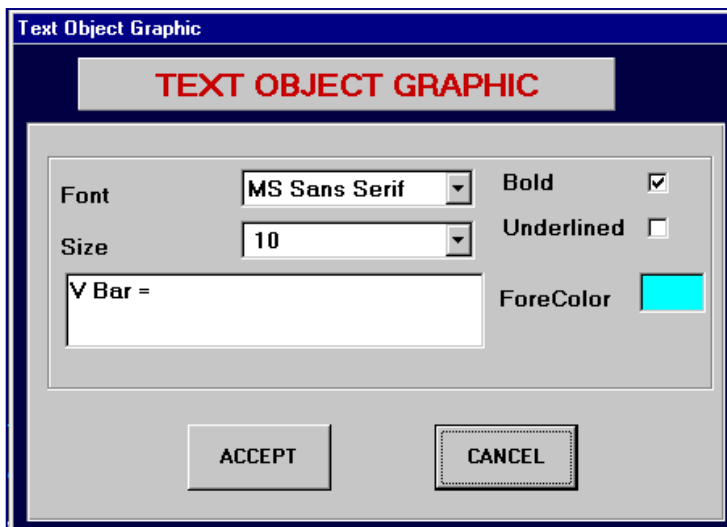
The TextRot Object is equivalent to the Object Text explained before. The main difference is the possibility to rotate it with a defined angle.

The OBJECT TEXTROT GRAPHIC Dialog Box allows to define the characteristics for this Object. They are **Font, Size** and **Color**, if we want a **bold** or **underlined** letter, the **Angle** to rotate the Text, the **Size** of the rectangle where the Text will be placed. In the Dialog Box also we can also enter the TEXT we want to show on the screen.

9.3 GENERAL FUNCTIONS

The general functions will operate when clicking on one of the buttons that appear on the bottom side of the Graphical Configuration screen:

Enable Movement: Changes the working mode, so that objects can be moved, but the rest of options associated to the object will be disabled (modify size, delete object...). There are two ways of moving an object: clicking and dragging it with the mouse, of selecting it with the mouse and then moving it pixel by pixel using the keyboard arrow keys.

Disable Movement: Returns from the *Enable Movement* status. It enables the rest of associated options.

Sel: This function allows to select a group of objects by creating a square with the mouse. All objects inside this square will be selected. This is used for copying a group of objects to a different bay.

UNDEL: Undo the Object deletion.

UNCOPY: Once several objects have been copied, they can be deleted using this option.

Insert tab: A new folder is inserted in the active folder. This option is not enabled for databases created with GE_CONF versions previous to 1.2.

Add tab: This button adds a new folder to those already configured. The Folder Data form is displayed, and there we can configure the features of the new folder (see section 9.1.)

Copy tab: Copies all the Graphical elements from the selected folder to another folder.

Remove tab: For databases generated with GE_CONF versions older than 1.2, the last configured folder is deleted. For versions GE_CONF 1.2 and higher, the selected folder is deleted.

Exit: Exits the Graphical Configuration window, and returns to the General Configuration window.

Save: Saves all the changes made in the database without exiting the Graphical Configuration window.

9.4 OBJECTS SIZE

When studding each Object, we have seen which of them allow to change their size. If we want to do this action graphically, we must select the Object clicking with the left mouse button. Then we drag on the Outside border of the object to modify its size. Additionally, the Objects allowing to change size include in the corresponding Graphical Form a field where we can modify the Scale factor.

9.5 MENUS ASSOCIATED TO OBJECTS

During normal operation, if we click with the right mouse button on any Object, a Menu associated to it will be displayed. The Menu options depend on the Object and on the configuration file conf.ini.

The possible Menu options are as follows:

```
Modify Object
Remove Object
Copy Object

Next Bitmap
Modify BMP
Update BMP
```
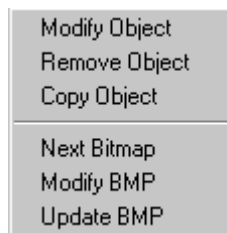
The three first options are fixed and they are always visible, independently from the type of Object.

The **Next Bitmap** option is only enabled for Objects with several BMP files associated to them, one per each possible status. This is the case of the Switchgear, Recloser, Latching and Present Objects.

The two last options will be enabled for Objects with a BMP file associated, and only if in their conf.ini exists a BMP files editor in **BMP_Editor**.

The meaning of each option is as follows:

Modify Object: Clicking on this option, the GRAPHIC Dialog Box corresponding to the selected object will be displayed (see the points 9.2.1 to 9.2.10). After the modifications are finished, click on the *Accept* button to save them.

Remove Object: The selected object is deleted.

Copy Object: The Object is copied in the memory. To paste the object in other location, click on the background (never on another object). Then we can drag the Object and move it to another place.

Next Bitmap: Shows in sequence the BMP files associated to the Object status.

Modify BMP: The BMP editor configured in the file conf.ini is run.

Update BMP: After modifying a BMP file, we click on this option to update the modifications in those Objects associated to the modified BMP.

10

TOOLS MENU

This Menu Option offers tools that can be useful during the Substation configuration process.
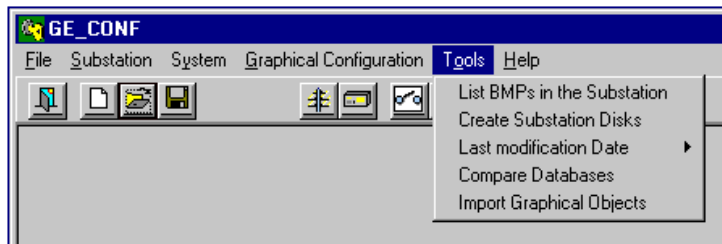
10.1 LIST BMPS IN THE SUBSTATION

As already explained, each database will include several associated BMP files as basic part of the Graphical Configuration. GE-CONF includes tools to manage this files easily.

Clicking on this option, a Dialog Box with the list of all the associated BMP files will be displayed. In this Dialog Box we can perform a series of operations related to these BMP files.

Print BMP list: A list of the BMP files is printed. Printing problems will be shown in a Message box.

Save BMP list in a file: The list of the BMP files used in the Substation is saved.

Selected BMP to hard disc: The selected BMP files are saved in the path chosen by the user.

10.2 CREATE SUBSTATION DISKS

When the Substation Configuration process (GENERAL TABLES and Graphical Configuration) is finished, GE_CONF gives us the option to generate the Substation floppy disks. With this floppy disks we can install the Substation in any other PC computer. These disks include the BMP files, device configuration files, device database and Substation database. Also the programs to manage the correct installation of the Substation are included.

10.3 LAST MODIFICATION DATE

With this option we can view the date when the last modification was made in the Substation database. This way we can keep a record of all the existing versions. GE_CONF only will store the dates of the last 50 modifications.

10.4 COMPARE DATABASES

In cases where we have two databases apparently similar, we can compare them using this option. It will display differences found in structure and contents.

At the moment the information only can be managed using ACCESS, as it refers to tables, number of rows, columns, etc.

10.5 IMPORT GRAPHICAL OBJECTS

This option is useful when we are generating a new database and we see that the graphical part is similar to other existing substation. In this case we can import all the graphical objects from the existing Substation. We need to know that all the Objects already created in the new Substation database will be deleted. Also we will need to associate each graphical object with the corresponding level 1 device.

11 ANNEX 1:   *SUBSTATION DATABASE*

This chapter describes the use of GE_POWER and the CONCENTRATOR of the Substation database generated by the GE_CONF. We go through the diverse tables that constitute the databases, describing how the data collected in these tables is interpreted.

11.1 CONFIGURATION READING

The configuration process is made in the level 2 (GE_POWER + CONCENTRATOR) only during the start-up process. During this process, all the tables that the Substation database needs are read. The information is read from the file L2.INI in the path C:\GE-NESISL2\GE_POWER.

The database must be in the directory C:\GE_NESIS\L2\CONFIG. Also the driver ODBC for the ACCES database must be added using the Control Panel in WINDOWS NT.

Every time the database is modified (this process can be done with the level 2 already started), the CONCENTRATOR and the GE_POWER must be started again to read the new configuration.

Among the tables that are in the Substation database we can distinguish 3 groups:

a) **General System Tables**.   Their main characteristic is that they are not related to any other table in the Substation. The modification of one of its fields does not affect other tables.

b) **General Substation Tables**.   They are related between them and they have elements that generate the third group of tables. They are built from the level 1 data collection. From these data will be generated the graphical objects.

c) **Graphical Objects Tables**.   They manage the previous tables constituting the level 2 interface.

To understand the level 2 configuration particularities in the next paragraphs we will explain briefly the different Tables.

11.2 GENERAL SYSTEM TABLES

11.2.1 SCREENS

This is a table used only by GE_POWER. In this table the user can define the different Layouts or folders that the GE_POWER will use to represent the Substation. The maximum number of folders that we can configure is 16. The characteristics of one folder are as follows:

IdScreen: Unique identification of the screen. This identification will be used in the tables corresponding to the Graphical Objects in order to fix each object in its corresponding layout.

NameScreen: Name of the layout. This is the text that will appear in the tab of the folder in the GE_POWER.

BackgroundColor: Background color.

Picture: Background picture.

This table relates the represented bays to each layout. The GE_POWER changes the tab of the folder when there is an alarm in any of the bays related to the folder. Through this table the GE_POWER knows if there is any relationship between the folder and a bay.

It relates a folder (layout on the screen) with a bay using the unique identifiers: The **IdScreen** of the table SCREENS and the **IdBay** of the table BAYS.

11.2.3 OPERATION MODES

There are four Operating Modes: **VIEW, OPERATIONS, SETTINGS** and **SYSTEM**. In this table the user can configure the functions that will be enabled for each Operation Mode. The functions that can be configured are as follows: **View, Alarms acknowledgment, View settings, Modify Settings, Command operations, Modify Access** (to add new users, to change passwords...) and **Exit Program**.

11.2.4 ACCESS LEVELS

The Access Levels table allows to combine the Operation Modes defined previously, assigning to each user the desired functionality. Nowadays we can define up to 10 access levels.

As regards the CONCENTRATOR, it is only important to know which of the access levels has priority (level 2 or level 3). This is defined in the **Priority** field. This is a text field that permits only three possible values: "LOCAL", " REMOTE" and "UNKNOWN". If the field contains "REMOTE", we can command operations from the level 3. Otherwise, the level 3 users will only be able to view the information and the control over the Settings and Operations is in the level 2.

The remaining fields are used by the GE_POWER:

View, Settings, Operations and **System** allow GE_POWER to determine if the access level has permission to enter to this operation mode.

AccessLevel is the number that the GE_POWER uses to identify the different Access Levels. In the Users Table managed by the GE_POWER (table that is configured from the GE_POWER by the users that have access to the Modify Access function) will be entered the access level associated to each user. The level is identified by a number.

IdTextScreen is an index to the DEFAULT_TEXT table. This table contains the texts associated to each access level. This text will be shown later by the GE_POWER. This way the user can check the active level every time. The index is related to a specific register in the DEFAULT_TEXT table. This table includes several columns, one per different language. The column that is accessed depends on the language in use in the GE_POWER.

11.2.5 COMMUNICATION_PARAMETERS

A system including GE_POWER and the CONCENTRATOR allows communication in two senses: A communication with the RTU (to keep the level 3 informed about the system status) and a communication with the level 1 devices (to monitor and control all the elements from level 2).

The COMMUNICATION_PARAMETERS table allows to configure all the necessary parameters for both ways of communications.

The **Connection** field admits several Text values. These values are "RTU1", "RTU2", and "LEVEL 1" (this would be the same as "DDS1", but we maintain this name for compatibility with previous versions), "DDS2" to "DDSi", and "ALPS1" to "ALPSi". These values are necessary for specifying through a communication port, which connection we want to establish.

The **ConnectionType** field is used for "RTU" type connections. This is a text field, allowing two different values: "SERIAL" and "RADIO_MODEM". These values indicate if the communication will be direct through a serial connection or if it will be through a Radio Modem. In this last case it will be necessary to control some signal sequences in the transmission and reception in order to have a correct communication.

For "LEVEL1" communication, as it will always be performed through a serial line with Level 1 devices, the **ConnectionType** field is used to define the "cycle checking period" of the CONCENTRATOR. The CONCENTRATOR will request information from the different devices according to the value indicated in the table CYCLE. This table is created by GE_CONF from the number of bays in the Substation. If, for any reason, there was any bay not communicating (e.g. disconnected for maintenance purposes) the performance of the system would result considerably affected, as the system would keep trying to communicate with these bays (they generate TimeOuts). To avoid this, the CONCENTRATOR checks every certain time (the time defined in this field) which bays are responding to communication in order to request information only from the active bays.

The remaining fields are used to configure the different typical parameters in the communication:

The **Communication Port**   is configured using a text field ("COM1" up to "COM20"). The user enters the name of the port he/she is going to use. If we want to disable communication to Level 3, we will enter a 0 in this field when configuring "RTU" type communication.

The **Baudrate** field   will include the standard speed (between 1200 up to 115200 baud).

The **StopBit** field   will indicate the number of stop bits of the transmitted characters. It will be 1 by default. Other possible values are 1.5 and 2.

The communication parity   will be configured in the **Parity** field. "E" indicates even parity, "O", odd parity and "N" no parity in the communication.

Finally, the **Bitnumber** field stores the number of bits transmitted by character. Its value will be 8 by default, but 5,6 and 7 are also possible values.

11.2.6 CYCLE

One of the main tasks for the CONCENTRATOR is to do a permanent polling over the bays in the Substation. In order to do this task as generic as possible and so to solve the possible Configurations in the Substation, including the different needs to refresh the information, the CYCLE table was created.

The CONCENTRATOR uses four types of messages defined as fast messages in the M-LINK communication protocol (these messages are answered immediately by the bays). The messages correspond to requests for STATUS, MEASURES, PANEL and INPUTS_OUTPUS.

The "cycle" is defined as the set of rows configured in the table CYCLE until one row contains in the field **Action**, the value "END_BUS". There are 4 of these cycles configured independently from the number of bays in the Substation. Each cycle must request the STATUS of each bay. This way it is ensured that the event collection is working properly, so that the CONCENTRATOR can order them correctly. It is also assured that the refreshment of all the information will be made between 400 to 700 msec. for a maximum of 30 bays.

Additionally to the status, each cycle will check the MEASURES from half the existing bays. In this way it is possible to get a refresh time for all the measures in the Substation in less than 2 cycles.

Finally, each cycle will request PANEL and INPUTS_OUTPUS data to 25% of the bays. This way we can get a refresh time of these data in 4 cycles (2600 sec.).

The algorithm used to build the table CYCLE is the one used by GE_CONF. As we can see, the measures and status request have priority. We can change this priority changing the number of requests of each type configured for each cycle.

We will se now an example for a total of 5 bays in the Substation

1º Cycle	2ºCycle	3ºCycle	4ºCycle
Status 1	Status 1	Status 1	Status 1
Status 2	Status 2	Status 2	Status 2
Status 3	Status 3	Status 3	Status 3
Status 4	Status 4	Status 4	Status 4
Status 5	Status 5	Status 5	Status 5
Measures 1	Measures 4	Measures 1	Measures 4
Measures 2	Measures 5	Measures 2	Measures 5
Measures 3	Panel 2	Measures 3	Panel 5
Panel 1	Panel 3	Panel 4	In/Out 4
In/Out 1	In/Out 2	In/Out 3	In/Out 5
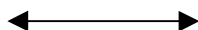
Statutes are refreshed each cycle: 400 msec maximum for 30 bays: 650 msec.)
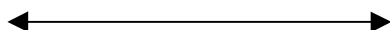
Measures are refreshed each 2 cycles
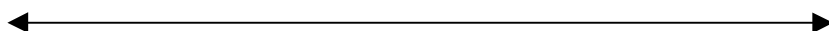
Panel and Inputs/Outputs are refreshed each 4 cycles

11.2.7 SYSTEM_COLORS

In this table, we will define the different colors that will be used for GE_POWER to display significant events. Hereafter we will explain the fields used for this purpose:

In the GE_POWER there is an alarms button (on the bottom right side of the screen) that changes its background color according to the highest priority alarm that is active in the system in a certain moment. In the fields **AlarmColorP1**, **AlarmColorP2**, **AlarmColorP3** and **AlarmColorP4** , we can configure the colors assigned to the different alarm priorities shown with this button.

In the same way, GE_POWER will use the configured colors (in these fields) in the tabs of each folder or layout that will appear on the screen. This will be an indication of the existence of alarms showing its priority, in any bay associated to a determined folder where the tab has changed its color.

The **NoAlarmColor** field shows the background colour for the alarms button and folder tabs when there are no alarms.

The fields **AlarmTextColorP1**, **AlarmTextColorP2**, **AlarmTextColorP3**, **AlarmTextColorP4** and **NoAlarmTextColor** will be used to configure the text color of the alarms button and folder tabs, in the same way that the previous fields were used to define the color of the background.

In the alarm panel of the GE_POWER, alarms show different colors depending on their status: Active. Non Active, Acknowledged and Non Acknowledged. The fields:
ActiveAcknowledgedColor,

ActiveNotAcknowlededegedColor,

NotActiveAcknowledgedColor and

NotActiveNotAcknowledgedColor

are used to configure the text colour of an alarm in each of the possible statuses. The background colour is configured in fields:
 ActiveAcknowledgedBackColor,

ActiveNonAcknowlededegedBackColor,

NonActiveAcknowledgedBackColor and

NonActiveNonAcknowledgedBackColor.

GE_POWER gives the possibility to activate a "beep" or a sound when new alarms are arriving to the system. The fields **BeepAlarmsP1**, **BeepAlarmsP2**, **BeepAlarmsP3** and **BeepAlarmsP4** give us the possibility to enable or disable this sound alert when the alarms of different priority are arriving.

11.2.8 DEFAULT TEXTS

These texts are used by the GE_POWER for labeling the Access Levels, and the Operations associated to switchgears and Reclosers.

-The **Index** field is used to identify without error one of these texts. This index is used by the table ACCESS_LEVELS in the field **IdScreenText**, for relating the text shown on the screen to its corresponding Access Level any time. It is also used by two tables of Graphical Objects: In the table Obj_Switchgear, its fields **IdOperationText1**and **IdOperationText2**, and in the table Obj Recloser, fields **IdTextBlock** and **IdTextUnblock**. In this case the texts are used to represent in the screen of the GE_POWER (when clicking over an object Switchgear or Recloser), the operations that can be commanded on that Object. In the table DEFAULT_TEXT it is possible to define up to 40 different texts. The ten first texts are reserved for Access levels and the remaining 30, for operations.

The fields **Spanish, English, French, Portuguese**, **German** and **Italian** contain the texts in the different languages that the GE_POWER can use. Depending on the active language, the GE_POWER will go to the specific column of data.

11.2.9 MODIFICATIONS _DATE

In this table, the GE_CONF will save the date and time of the changes made in the Substation database. This field is used to follow-up the different database versions. GE_CONF will keep the dates of the last 50 modifications, in order to limit an unnecessary growth of this table.

11.3 GENERAL SUBSTATION TABLES

As already explained, the GENERAL TABLES collect the data configured in the different devices. The elements related to each will be identified through a relation established from the table BAYS to tables SWTICHGEAR, EVENTS, OPERATIONS, MEASURES, STATUS, INPUTS_OUTPUTS, OLTC, SWITCHGEAR_ALPS, EVENTS_ALPS, OPERATIONS_ALPS, MEASURES_ALPS, STATUS_ALPS, INPUTS_OUTPUTS_ALPS and PANEL_ALPS.

Additionally each data of these tables will be identified by an "Identification". This identification will be used to control the access from any of the Object-Tables that compose the Graphical Interface. Finally, in theses tables will be added the necessary data to configure each data for its treatment in the level 3.

11.3.1 SUBSTATION

The CONCENTRATOR needs the address to identify each Substation with a unique name for the level 3. For this purpose, it will read the field **ConcentratorAddress** from the Substation table, where this address is stored. It must be a number between 0 and 254. In case there is no connection with level 3, the CONCENTRATOR does not read this data.

GE_POWER reads from this table the Substation Name (from the field **Substation**) in order to display it on the status bar.

The field **Comments** is a text field. This field is used only to give information to the user.

The field **GE_CONFVersion** is also a text field, and it gives information about the GE_CONF version that created the Substation Database.

This table contains one row per each bay configured in the Substation. For each bay, a series of general features are specified. These features are important for the correct operation of the program, e.g. the model, the configuration file, whether there is oscillography, events, etc.

The meaning of the different fields in the table is as follows:

IdBay: This field identifies each bay in the substation with a unique name. In this way, when the Unit number of a bay is changed, it affects only to the table BAYS. When a bay is deleted from the table, all the data related to it will be deleted in the GENERAL TABLES, including (as we will see next) the graphical tables. The identification does not need to be a consecutive number.

PositionMemory. This field is used independently from the identification, as a method to storage information in consecutive memory fields. We need to guarantee that this field is unique and consecutive, starting by 0. This way, the information from each bay is related to its corresponding unit number. The number must be from 0 to Number of bays – 1.

UnitNumber: This is identification of a bay. It is stored in the level 1 device. This is how the device is identified when communicating with the CONCENTRATOR.

Password: This is the passcode that the relay reads and recognizes to accept commands from the communication port. It is used by the GE_POWER and by the CONCENTRATOR to operate on the device.

Type: Indicates the type of device: 0 in case of the ALPS, and 14 in case of a DDS.

Model: Relay model in case of a DDS family device.

ConfigurationFile: Configuration file of the device, generated by the GE_INTRO program. This file is generated from the level 1 device database. Then, the user definitions are added. The path where the configuration files are (for the Substation) must be indicated in the file conf.ini.

GE_CONF will use the device database and the configuration files, to generate the GENERAL TABLES of the Substation database in case of the DDS, and the databases for the ALPS. From these tables, it will select the necessary elements storing them in the different tables. In this process it will identify and associate each element to the corresponding bay. With these elements, and adding the necessary characteristics, the graphical objects necessary for monitoring and controlling the substation from GE_POWER will be generated.

Identification: Relay name.

Connection: ndicates the connection associated to the device. Each connection corresponds to one communication port. We need to take into account that each connection allows up to 16 devices type DDS, but only one type ALPS. The allowed values in this field are the texts: "DDS1", "DDS2",...,"ALPS1", "ALPS2",...

OscilloTemplate: Defines the file that will be used as template for this device when the GE_OSC is activated from GE_POWER.

The next fields are used by GE_POWER and by the CONCENTRATOR to know whether the device can provide certain information. The field **Measures** will indicate the presence of measures. The field **EventsPROT** whether there are events generated by the protection and the field **EventsCTRL** if there are control events, **Oscillography**, and **current demand**, etc.).

In case of the relays model ALPS, the following fields are used: **FaultsNumber** to know the number of faults stored in the relay, and **CyclesNumber** to know the number of cycles per each fault that are stored.

Switchgear table stores the set of switchgear objects defined in each device type **DDS** in the Substation (because they are part of the BAYS table). The tables from the switchgear is collected are *TimeOpenClose CTRL* (configuration files), *GE_Intro Configurable Switchgear CTRL* and *GE_Intro FixedObjects COMU* (databases).

IdBay will collect the value corresponding to the bays where the switchgear is located. Additionally the **Identification** will be filled with a number that will identify each switchgear in the Substation.

The fields **Text, CPU, PositionBuffer, PositionNibble** and **Contacts** are obtained from the relay configuration files and databases. The **Text** field is used to be displayed on the GE_POWER screen, the **CPU** field shows whether the switchgear is managed by the CONTROL CPU or the PROTECTION CPU, and fields **PositionBuffer** and **PositionNibble** are used to place the switchgear status in the status buffer. The device sends this status buffer after a status request. **Contacts** field indicates whether the switchgear has one or two contacts (it has not been used yet).

We need to take into account the different treatment made for the CONTROL switchgear and for the PROTECTION switchgear. The PROTECTION switchgear is fixed in the model database (type and associated operations are fixed). The CONTROL switchgear is configured through the configuration file, but its type and its associated operations are not known. Therefore, they must be configured in the GE_CONF.

The **Type** of switchgear can be one of the following: GENERIC, CIRCUIT BREAKER, SWITCH, LATCHING or RECLOSER. In case of a PROTECTION switchgear, this value can not be modified. If it is a CONTROL one, it can be modified.

The same occurs with fields **IdOperation1** and **IdOperation2** that contain the identifications of those operations associated with the switchgear. The numbers filled here correspond to the field Identification of the associated operations in the table OPERATIONS. In case of a PROTECTION switchgear, the associated operations can not be modified. If it is a CONTROL one, they can be modified.

The field **SwitchgearNumberRTU** identifies a switchgear in front of the level 3 and **SwitchgearGroupRTU** is used for including the switchgear in a group of data, when acquiring data from level 3.

11.3.4 EVENTS

This table includes all the Events (Alarms + Signaling) from each of the **DDS** type bays identified in the table BAYS (according to the field IdBay). Each of these bays must have associated a configuration file generated by GE_INTRO. GE_CONF collects all the configured events in each bay (from the tables Events PROT, Events CRTL and Events COMU) from their configuration files, and then builds the table EVENTS in the substation database.

The fields **NumberAlarm**, **Text** and **Alarm** (this last field indicates if the selected event is an alarm or a signaling) are configured in each bay (device configuration files). The field **Text** will contain the text that will be displayed by GE_POWER (in the alarm panel and in the event recorder screens).

The field **NumberAlarm** is a number between 1 and 96, used by each device to identify its alarms. With this field and with the **IdBay** (GE_CONF fills this field with the data corresponding to the bay where the event is), the event is clearly identified in the Substation. Additionally, the field **Identification** is filled with an identification number and so the identification is immediate. The field **CPU** is filled with the corresponding CPU where the event in the device is.

The user must configure the remaining fields, as they can neither be obtained from the configuration files, nor be filled by GE_CONF.

The field **NumberAlarmRTU** defines an event to be sent to the level 3. Therefore, the events with value −1 will not produce events to the level 3, although they can be part of an alarm logic that will be explained later in this manual.

The field RTUType can have the following values:

SINGLE: Single events generated when a change of status is produced. A unique **NumberAlarmRTU** identifies them. As group number, in the field **GroupAlarmRTU**, they can have the value 0, or a number between 1 and 16 (depending on whether the event is part of a group of data acquisition for the level 3).

DOUBLE: They must be 4 consecutive events defined in the device (that means, with consecutive AlarmNumber). They have a unique value of **NumberAlarmRTU**, because for the level 3 they will conform a single event, but with 4 possible status. In the field **GroupAlarmRTU**, they will have a number between 1 to 16, because they are referred to important data as the switchgear (in this case we need not only to know the events, but the device status in any moment).

LOGIC: They can have the field **NumberAlarmRTU** with a value equal to −1 if the event is not reported to the level 3. If the event needs to be sent to the level 3, they will have other number. They are part of a more complex Alarm Logic that will be explained after, but this is the first step to configure them. The number GroupAlarmRTU is managed as we explained in the SINGLE alarms.

The field **GroupAlarmRTU** indicates whether the event is part of a group of data acquired for the level 3 (in this case it must have a number between 1 to 16). The entirety of events that conform each group must be all of the same type, because in each group besides is specified the type of ASDU (format in the IEC-870 communication protocol) they must have for being transmitted to the level 3. Therefore, the SINGLE events will be loaded in a certain group with the corresponding ASDU used for transmission. The same occurs with the LOGIC events, that are treated in the same way as regards grouping. DOUBLE events must be grouped separately, because they use a different ASDU.

The groups will be used in another data that form part of the level 3 data acquisition process, such as measures, or OLTCs.

Both the structures that store the whole of configured events, and the ones that store the different groups must be ordered according to RTU numbers, because the construction of the corresponding ASDUs in the Acquisition data process is made according with this criteria.

The field **Priority** is a numerical field used to give the Alarm events a priority between 1 and 4, being 1 the maximum priority and 4 the minimum. This priority is used by GE_POWER to classify and manage an alarm according to its priority. For example, we can use a filter in the alarm panel, in order to view only the events with a determined priority.

Group of operations that can be commanded on devices type **DDS** connected to the Substation, and collected by GE_CONF from the tables *PreviousTime CTRL* from the configuration files, and *Pman* from the relay model databases.

The fields **NumberOperation** and **TextOperation** are automatically filled, according to their values in the configuration files generated by the GE_INTRO. The same will happen with the **CPU** through which the operation will be sent. The field **IdBay** is filled by GE_CONF, with a value corresponding to the bay where the operation is. With the **NumberOperation** and the **CPU**, an operation is identified for a determined bay. The field **Identification** is used to clearly identify an operation in the Substation.

The specific fields used by the CONCENTRATOR to communicate with the level 3 are: **NumberOperationRTU** and **StatusOperationRTU**. Both are used to establish the relationship between the identifications used in the level 3 for an operation and the ones used in the level 1 devices. The possible values for the status field are "ON" and "OFF". A unique **NumberOperationRTU** with different ON and OFF status in **StatusOperationRTU** is used to command 2 operations in the device, for example "OPEN" and "CLOSE".

For the CONCENTRATOR, only those operations with **NumberOperationRTU** different to –1 will be loaded, as these need to be managed by communications. In the operations table and the CONCENTRATOR all of them will be present.

11.3.6 MEASURES

This table groups the different measures from all bays with **DDS** devices in the Substation. The measures are collected from the tables *Pcon, Pmed* and GE_*Intro MeasuresAnalogCounters* (from the different model databases).

The field **IdBay** will acquire the value corresponding to the bay where each measure is. The **Identification** field will identify each measure in the Substation.

The following fields will be filled with the data from the model databases: **Type, CPU** where the measure is, **BayBuffer** to know the position where the measure is in the measures buffer that the device sends when a measure request is received. **TypeData** indicates the type of the measured value (it will be 3 for Long, 4 for Float y 5 if it is an OLTC). **Name** will include a text associated to the measure, **Units** and the following two, **IndexCounter** and **TableCounter**, used for the PULSE COUNTER, in order to indicate the index of the counter and the table where the counter value is requested.

The field **Type** will receive one of the following 4 values (there are 4 type of measures):

a) "NORMAL": Such as Currents, Voltages, etc. They are configured in the devices with text, units and type of data.
b) "COUNTERS": Similar to the NORMAL ones, but they are sequentially incremented. E.g. Number of openings, Number or reclosures, etc.
c) "ANALOG": They are collected from the Analog Measuring boards in the device. Therefore, the text of the measure only specifies "ANALOG MEASURE" and the device does not know its units. The upper and lower limits need to be configured (in **AnalogLowerLimit** and **AnalogUpperLimit**), in order to calculate the correct values that are being measured (calculating the minimum and the factor of the structure in the measure).
d) "PULSE_COUNTERS": The pulse counters are measures that the device increments in function of the pulses received. The refreshment can be examined in the CONCENTRATOR as a normal measure, but additionally they can be frozen or reset. They can acquire the freeze values independently from the fresh ones. To do this last acquisition, we use fields **IndexCounter** and **TableCounter**. The field **IndexCounter** uses the values 1 to 4 according to the 4 pulse counter configured in the devices. For the pulse counter the **NumberGroupRTU** must be a number between 17 and 20.

Those fields related to the configuration of measures as regards Level 3, identify each measure in a similar way to how events are identified. Measures are divided in two groups, but with the common fact the system will only

treat those with a **NumberMeasureRTU** other than –1, and **GroupMeasureRTU** between 1 and 16 for measure type "a", "b" and "c", and 17 to 20 for measures type "d".

The field **ScaleRTU** is used to do unit changes between the measure received by level 2 and the measure that needs to be transmitted to level 3. Finally, **DecimalRTU** specifies the number of decimal digits of the measures sent as integer ones in the corresponding ASDU for measures.

The fields **AnalogLowerLimit** and **AnalogUpperLimit** were described before as fields used only for analog measures. This is not totally true; there are cases when it is mandatory in the communication protocol with the level 3, (e.g. using the INDACTIC communication protocol) where it is needed to sent the measures as counters (as the device collects them). In these cases, the level 2 must do the opposite conversion to the one done by the device. Therefore, these fields are used for all types of measures. A similar case occurs in the field **FactorCounter**: If the level 3 communication protocol requires it, the counters must be sent as the pulse counters (as they were collected), before they are applied a conversion factor defined in the device. In this case this field could be used to apply the inverse conversion to the one made in the device.

The last four fields are used to give the possibility to generate L2 Events when the measures exceed a pre-defined value. They are: **UpperValueLimit** for the value that a measure should not exceed, and **LowerValueLimit** for the value that the measure should not fall below. The fields **NumberEventL2Up** and **NumberEventL2Lo** indicate the field *AlarmNumber* from the table EVENTS_L2 for the event generated by the measure.

11.3.7 STATUS

As the rest of tables, the STATUS table groups all the status of all bays with a **DDS** device. This table does not incorporate any data further than what is defined in each device, because no treatment for the level 3 is required. Therefore, it is used to identify the whole of status in any device, and it allows its management through the **Identification** in the graphical objects created to represent the status in the graphical layouts in GE_POWER.

11.3.8 INPUTS_OUTPUTS

As the previous one, the table "INPUTS_OUTPUTS" groups all the information needed to manage the input/output in all bays with a **DDS** device, without any additional data. We must only define in the GE_CONF the text that will identify in the graphical layout each Input/Output.

It allows access through the **Identification** so that we can configure any graphical object from this data.

11.3.9 OLTC

Using this table we can configure all the OLTCs existing in the Substation (up to a maximum of 10). The OLTC is already configured in the **DDS** devices (in the measures table of the model database).

The fields **Identification**, **IdBay**, **Text** and **BayBuffer** are filled as described for the measures, and they are used in the same way.

NumberAlarmRTU and **GroupOLTCRTU** identify the event that is generated every time the OLTC changes the TAP, and the group that level 3 must request in order to know the situation of the OLTC any time. Each configured OLTC must have a different group, according to the specifications of the IEC-870-5-101 standard. This can change for other communication protocol used with the level 3.

NumberOperationRTU, **IncreaseOperation**, **DecreaseOperation**, **CPUIncrease**, and **CPUDecrease** relate the command number in the level 3 for operations of Increasing or decreasing the tap, with the corresponding necessary commands in the device for each referred operation. This is done from the data in the table of operations described before and the CPUs where the messages must be sent to perform the requested operations.

The fields **MinimumTap** and **MaximumTap** limit the minimum and maximum position in each OLTC in order to avoid failures in operations. The CONCENTRATOR, before sending an OLTC command to level 1 units, checks these TAP limits to avoid any command that would exceed their values.

Format: Level 1 devices admit 3 different formats for the OLTC. These are: BCD, GRAY and BINARY. The CONCENTRATOR must read these formats correctly to know the exact TAP position.

In the field **TimeOut** we configure the maximum time that the OLTC uses to change the TAP. In case this TimeOut is elapsed without any change in the TAP position, the CONCENTRATOR generates a level 2 event. This event is described in the table EVENTS_L2.

11.3.10	**EVENTS_L2**

In this table, we configure those events that do not come from the bays. They must be collected and organized by the CONCENTRATOR as a complement to the received information. There are 4 different types:

a) ***Events caused by communication failures with a bay***: They are configured in positions 0 to 29 of the table (related to the maximum number of possible bays, that is, 30).

b) ***Events associated to OLTC´s***: They are placed in positions 30 to 39. We assume a maximum of 10 OLTCs per Substation. They are activated when a command on one of them is sent, and there is no change in its position during the defined TimeOut.

c) ***Access levels***: They are configured in positions 40 to 49. We assume a maximum of 10 possible Access levels. They inform level 3 each time that a change in the Access level is produced.

d) ***Logical Operations***: They provide the system with great flexibility, allowing to combine alarms from different bays with the ones generated in the CONCENTRATOR. The possible logic operations until now are: AND, OR and NOT. They are configured starting from position 50.

e) ***Measures Events***: These events are generated by the value reached by a measure at a given time, exceeding the Upper limit, or falling below the Lower limit. They are configured starting from position 100.

The loading of table EVENTS_L2 to the corresponding variables used in the program is made in a similar way for the above mentioned groups "a", "b" and "c", while for group "d" it's part of the process that will be explained in the alarms LOGIC.

In case a row has the field **Text** empty, it is considered that the event is not configured. Similarly to events that come from the bays, the field **NumberAlarmsRTU** can be –1, in case the event is not interesting for level 3, although will be viewed in Level 2, or with a value if they need to go to an upper level.

The meaning of the field **GroupRTU** is similar to the table of events. When the RTU number is different than –1, the field group where the event is can be configured (if we want the event to be part of the Acquisition Data Group). Currently, the events from the CONCENTRATOR are treated as SINGLE events.

As regards Logic Alarms, the above mentioned group "d", their configuration is described hereafter: To understand the configuration of the Logic Alarms, we will see the following example:

1. Rules of the field Logic from EVENTS_L2 table

a) The operators will be grouped in the following way (01 45), (L2 07), etc. Where the first two digits identify the bay (**IdBay**) in case of an event for a device, and L2 in case of an level 2 event. The next digits are the event number (**NUMBERALARM**) configured in the corresponding table.

b) The operator NOT can only operate over a single operator, not over operations. It must go between parenthesis and with the following format:

(ƀNOTƀ(01ƀ04)) where ƀ represents blanks

c) There is not global parenthesis for the operation

d) The operations must be grouped using parenthesis every 2 operators (only one parenthesis in case of the NOT operator).

Example: (((00 34) OR (01 34)) AND (02 41)) OR ((03 34) OR (NOT (04 34)))

11.3.11   SWITCHGEAR_ALPS

In the table Switchgear, the system stores the switchgears configured in **ALPS** relays installed in the Substation. The Switchgear associated to these relays is collected from the table *PApa ALPS_XPO* (relay database).

IdBay will acquire the value corresponding to the bay where the Switchgear is. Additionally **Identification** will be filled with a number that will identify the Switchgear in the Substation.

Fields **Text, Where, Byte** and **Mask** are obtained from the relay databases. The field **Text** is used to display the Switchgear on the GE_POWER screen, and fields **Where, Byte** and **Mask** are used to place the status of the Switchgear in the status buffer sent by the device as an answer for the request received from level 2 or level 3. The field **Type** is always filled with the text "CIRCUIT_BREAKER_ALPS".

Fields **IdCommand1** and **IdCommand2** contain the Identifications of the operations associated to the Switchgear. The numbers in these fields are the ones corresponding to the associated operations in the table "OPERATIONS_ALPS".

Field **NumberCircuitBreaker** is a byte. It contains the number of the Circuit Breaker (1 or 2) in ASCII format, that is: 49 or 50.

11.3.12   EVENTS_ALPS

This table is used to configure the Events for each **ALPS** bay in the table BAYS, according to the field **IdBay.** These events the ones defined in table **Peve ALPS_XPO** of the relay databases.

Fields **NumberAlarm** and **Text** are collected from the device database. The field **Text** contains the text that will be displayed by GE_POWER in the Alarms panel and Event Recorder.

Field **NumberAlarm** is a number that each relay uses to identify its alarms. With this field and **IdBay** (that GE_CONF fills in with the bay where the event is) the event is clearly identified in the Substation. Additionally, the field **Identification** is filled with a number that will identify each event, in order to achieve an immediate identification.

In order for the CONCENTRATOR to know the origin of the data that activated each event, we need to fill another three fields: **DataOrigin** (indicates the origin of the data): "STATUS" for the table STATUS_ALPS, "INPUT" for the table "INPUTS_OUTPUTS_ALPS" with type = Input; "OUTPUT" for the table OUTPUTS_ALPS with Type = Output. The other fields to fill are **ByteOrigin** (indicating the byte in the corresponding table), and **MaskOrigin** (To obtain the bit inside the byte).

The remaining fields must also be defined by the user. The field **NumberAlarmRTU** defines an event for the level 3. Therefore, events with value -1, will not generate events to level3.

The field **TypeRTU** can be filled with the values PARTE_ON and PARTE_OFF, because we need to have two events from an ALPS relay in order to define an event for level 3. One of the two events will indicate when the signal has turned "ON" and the other one when it has turned "OFF". Both events (PARTE_ON and PARTE_OFF), that are identified by a single level 3 event, must have the same **NumberAlarmRTU** and **GroupAlarmRTU**.

The field **GroupAlarmRTU** indicates if the event is part of a Data Acquisition Group for the level 3. In this last case the event must have a number between 1 and 16.

11.3.13 OPERATIONS_ALPS

Group of operations born by the **ALPS** units connected in the Substation. The GE_CONF collects these commands from the *Pman* tables (located in the relay databases).

The fields **NumberOperation** and **TextOperation** are the ones configured in each of the database bays. The field **IdBay** is filled by GE_CONF with the corresponding bay where the operation is. With the **NumbeOperation** an operation is identified for a specific bay. The **Identification** field is used to clearly identify the operation in the whole Substation.

The field **NumberBreaker** is used to identify if the operation affects the Circuit Breaker 1 or 2.

The specific fields used by the CONCENTRATOR for communication to level 3 are **NumberOperationRTU and StatusOperationRTU**. Both are used to establish the relationship between the Identifications for operations used in the level 3, and the ones used in the level 1 units. The possible values for the status field are "ON" and "OFF". A single **NumberCommandRTU** with different status ON and OFF in **StatusCommandRTU** is used to execute 2 operations in the corresponding devices. E.g. "Open" and "Close".

The CONCENTRATOR will only load those operations with **NumberCommandRTU** other than -1 (these are the operations managed by communications). In the table of operations and for level 2 , all of them will be present.

11.3.14 MEASURES_ALPS

This table groups the measures of all **ALPS** bays defined in the Substation. They are collected from the *Pmed* table in the relay databases.

The field **Id Bay** will acquire the value corresponding to the bay where the measure is, and **Identification** will be filled with a number that will identify each measure in the Substation.

The next fields will be filled with the information from the relay database: **Type** (at present all are NORMAL), **Order** indicates how the measures are ordered in the buffer, **LenPosBuffer** to know the length of the measure (in bytes) in the buffer and **PositionBuffer** to know the position of the measure in the buffer of measures. **TypeData** indicates the value type of the measure (it will take the value 3 for the length, 4 for Float), **Name** will include the Text associated with the measure and **Units.**

The field **Type** will always be filled with "NORMAL".

The fields relative to the configuration of the measures for the level 3 identify each measure as already explained for other cases. Fields **NumberMeasureRTU** and **GroupMeasureRTU** will be filled with the corresponding values.

The field **ScaleRTU** is used to do units´ changes between the measure received in the level 2 and the one that needs to be transmitted to the level 3. Finally, **DecimalRTU** specifies the number of decimal digits of the measures sent as integer in the corresponding ASDU for measures.

The last four fields are the ones used to generate L2 Events for measures. They are **ValueUpperLimit** and **ValueLowerLimit**. The first one sets the maximum value that the measure must exceed to generate an Level 2

Event, and the second one, the minimum value. The fields **NumberEventL2Up** and **NUmberEventL2Low** indicate the field *NumberAlarm* of the table EVENTS_L2 for the event generated by the measure.

<div style="text-align: right">

11.3.15   STATUS_ALPS

</div>

The table STATUS groups all the status from __ALPS__ bays. This table does not include any other data than what is defined in each device, as it does not require further treatment for level 3. Therefore, it is used to identify the status of each relay, allowing its management through the **Identification** in the Graphical Objects created to represent the status in the GE_POWER. The fields **PositionBuffer** and **PositionBit** are used to identify the exact bit where the status value can be found in the status buffer.

<div style="text-align: right">

11.3.16   INPUTS_OUTPUTS_ALPS

</div>

Group of Inputs_Outputs defined in __ALPS__ devices. The field **Type** identifies if there is an input or an output and the fields **PositionBuffer** and **PositionBit** are used to define the position of the status bit of the input or output in the buffer.

<div style="text-align: right">

11.3.17   PANEL_ALPS

</div>

This table defines the Status, Inputs or Outputs that the user wants to be treated as alarms, in order to display them in the Alarms Panel. The field **DataOrigin** indicates the data origin: "STATUS" for the table *STATUS_ALPS*, "INPUT" for the table *INPUTS_OUTPUTS_ALPS* with Type = Input, "OUTPUT" for the table *OUTPUTS_ALPS* with type = Output. The field **ByteOrigin** indicates the byte of the data origin in the corresponding table, and **MaskOrigin** the bit in the byte. **NumberAlarm** will be filled with consecutive numbers for the alarms in the same device, and **Text and Priority** will be configured with the adequate values.

11.4 TABLES OF GRAPHICAL OBJECTS

Graphical Objects define the interface that the final user will view through a collection of layouts that can be configured adding any object. Each object has a set of properties. This way, the same data can behave differently if it is associated to different objects.

The characteristics of each object, as well as the fields that customize them in the different tables will be explained later.

<div style="text-align: right">

11.4.1 TABLE OBJ_SWITCHGEAR

</div>

The table "Obj_Switchgear" gathers the information from the switchgear of __DDS__ units existing in the Substation (described in the table "SWITCHGEAR"). If we want to manage the switchgear in this table as Graphical Objects, so that they are displayed in the GE_POWER screens, we need to define a series of characteristics for them to behave in accordance.

A Switchgear type graphical object is displayed on the screen using different pictures (or BMP files). Each BMP file corresponds to one of the Switchgear Status. When the status changes, GE_POWER detects the change through the communication link (with the level 1 devices) and displays it on the screen, replacing the associated BMP file by the one corresponding to the new status.

The table contains the following fields:

- The field **IdObject** identifies the object in the Substation. All the Graphical Objects tables will include this field. The value in this field must be unique in all the different Graphical tables.

- The field **Identification** relates the Object Switchgear to the corresponding Switchgear. The value in this field is the same as in the field **Identification** in the table "SWTCHGEAR" described before.

- The fields corresponding to the different pictures associated to the Switchgear statuses are text. They will include the name of the corresponding BMP file. They are as follows: **OpenPicture** (corresponds to the file name that contains the picture representing the status "Open"), **ClosePicture** (file that contains the picture representing the status "Close"), **UnknownPicture** ("Unknown" Status), **ErrorPicture** ("Error" status) and finally **NonPresencePicture** (corresponds to the file name that contains a picture representing the non presence of the bay where the Object is.

- Fields **X** and **Y** store the horizontal and vertical axis where the object is with respect to the GE_POWER screen.

- The field **Screen** will coincide with the field **IdScreen** in the table SCREENS corresponding to the GE_POWER screen where the object is being displayed.

- **Scale** will be the scale factor that is applied to the picture to display it on the screen.

- The flag **Operational** indicates if we can command an operation over a Switchgear object from the GE_POWER.

- The fields **IdTextOperation1** and **IdTextOperation2** are the index for table DEFAULT_TEXT where the text associated to both operations associated to the Switchgear is stored.

11.4.2 TABLE OBJ_RECLOSER

The table "Obj_Recloser" collects the RECLOSER switchgears (for DDS units) from the table SWITCHGEAR (they will be treated as graphical objects in GE_POWER.

They will be similar to the switchgear, with the exception that they will have seven different pictures associated (in the Obj_Switchgear there are 5), because a Recloser can present up to 7 different status. The fields of this table are detailed now:

- **IdObject**. As in the previous section, this field identifies the object in the Substation

- The field **Identification** is similar to the field **Identification** of the Switchgear in table "SWITCHGEAR", corresponding to object Recloser.

- The fields that correspond to the pictures associated to the Recloser status, will be of the text type. They will include the file name where the BMP picture is. They will be as follows: **PictureOutofService** (name of the file that represents the status "Out of Service"), **PictureBlock** (file that contains the picture representing the "Blocked" status), **PictureStandBy** (contains the picture that represents the "Stand By" status), **PictureLockOut** (file with picture representing the "Lockout" status"), **PictureInService** (file with picture representing the "In Service" status), **PictureInProgress** (file with picture representing the "In Progress" status) and **PictureNoPresence** (file with picture representing the "Non Presence" of the bay where the object is).

- Fields **X** and **Y** store the horizontal and vertical axis where the object is in the GE_POWER screen.

- The field **Screen** will coincide with **IdScreen** in table SCREENS, corresponding to the GE_POWER screen where the object is being displayed.

- **Scale** will be the scale factor that is applied to the picture to represent it on the screen.

- The flag Operational indicates that we can command an operation on a Switchgear object from GE_POWER.

- Field **IdTextBlocking** is an index to the table DEFAULT_TEXT, where we find the text associated to the operation Block Recloser. This is the text that GE_POWER will use to represent the operation associated to the Recloser. **IdTextUnblocking** is an index to the table DEFAULT_TEXT where we find the text associated to the operation Unblock Recloser.

11.4.3 TABLE OBJ_OLTC

The table "Obj_OLTC" contains the information of the graphical objects of the OLTC corresponding to elements in the table OLTC. An object OLTC is a text that represents in GE_POWER the current position of the OLTC of the associated table OLTC. Therefore, we will need to configure the features for text: font and size.

- **IdObject** identifies the Object in the Substation.

- The field **Identification** will coincide with the **Identification** in the table "OLTC" where the OLTC associated with this graphical object is described.

- The field **Font** will indicate the font used to display the OLTC, and the field **Size** will indicate the size. **ForeColor** will indicate the color used for the text.

- Fields **X** and **Y** store the horizontal and vertical axis where the object is in the GE_POWER screen.

- The field **Screen** coincide with the field **IdScreen** in table SCREENS, corresponding to the GE_POWER screen where the object is being displayed.

11.4.4 TABLE OBJ_ALARM

The table "Obj_Alarm" contains the **<u>DDS</u>** units' alarms that will be displayed through graphical objects. They correspond to those elements in the table EVENTS with the field Alarm = Yes. Alarms are displayed on the screen through different .BMP files that will indicate the different alarm statuses. They can also blinking according with their status.

- **IdObject** identifies the Object in the Substation.

- The field **Identification** will coincide with field **Identification** in the table "EVENTS", where the Event associated to this Graphical Object is described.

- The fields corresponding to the different pictures associated with the alarm status are texts. They include the file name of the corresponding .BMP file. They are:

    - **PictureActiveAcknowledged,**

    - **PictureNotActiveNotAcknowledged,**

    - **PictureActiveNotAcknowledged,**

    - **PictureNotActiveAcknowledged.**

    - **PictureNotPresent** will be the name of the file that contains the picture that represents the non-presence status of the bay where the object is.

- The following fields indicate if the Object must blink or not for each of the statuses:

    - **BlinkingActiveNotAckwonledged,**

    - **BlinkingActiveAcknowledged,**

    - **BlinkingNotActiveAcknowledged,**

    - **BlinkingNotActiveNonAcknowledged.**

- Fields **X** and **Y** store the horizontal and vertical axis where the object is in the GE_POWER screen.

- The field **Screen** will coincide with **IdScreen** of the table SCREENS corresponding to the GE_POWER screen where the object is being represented.

- **Scale** will be the scale factor that is applied to the picture when displayed on the screen.

11.4.5 TABLE OBJ_OPERATION

The table "Obj_Operation" contains the objects Operation associated to the elements of the table "OPERATIONS" already explained. These objects are represented by a button. We can associate to this button either a text or a picture. Its characteristics are defined in the following fields:

- **IdObject** identifies the Object in the Substation.

- **Identification** is an index associated to the table "OPERATIONS", where the associated operation is described.

- The field **TextOperation** contains the text corresponding to the operation in the table "OPERATIONS".

- Fields **X** and **Y** store the horizontal and vertical axis where the object is in the GE_POWER screen.

- The field **Screen** will coincide with the field **IdScreen** in table SCREENS corresponding to the GE_POWER screen where the object is being represented.

- Fields **Picture** and **Text** contain the file name containing the picture embedded in the button, or the text that appears in the button in each case.

- **Font** indicates the text font, and **FontSize** is the font size of the letter applied.

- **WidthButton** and **HeigthButton** correspond to the size (in twips) of the Width and Height of the button. These sizes will be used to define the button size, in case it has a text associated. Case to have a picture associated these two fields are ignored.

11.4.6 TABLE OBJ_MEASURE

The table Obj_Measure describes the different graphical objects associated to measures from the **DDS** units that can be viewed in GE_POWER. These texts display the current value of the associated measure in the screen. The fields defining their characteristics are:

- **IdObject** identifies the Object measure in the Substation

- **Identification** is an index to the table "MEASURES" where the associated measure is described.

- The fields that describe the characteristics of the text are **Font** (Type of letter of the measure and **Size** (font size).

- The field **ScalePresentation** contains the scale factor that will be applied to the measure before being displayed on the screen by GE_POWER.

- The number of decimal digits that appear on the screen is defined in **DecimalNumber**.

- Fields **X** and **Y** store the horizontal and vertical axis where the object is in the GE_POWER screen.

- The field **Screen** will coincide with **IdScreen** of the table SCREENS corresponding to the GE_POWER screen where the object is being displayed.

- The Text that represents the value of the measure can change its color depending on the value. So **Colorband1** is the color when the value is lower than LimitBand12, **ColorBand2** is the color when the value is lower than LimitBand23, **ColorBand3** is the color when the value is lower than LimitBand34 and **ColorBand4** is the color when the value is higher than LimitBand34.

- The fields **LimitBand12**, **LimitBnad23** and **LimitBand34** are used to determine the limits between the different bands, and so apply the colors depending on the value of the measure.

The objects of this table can present two status (ON, OFF) and a third one associated to the condition of no presence of the associated bay where the element is. They are used to represent a status, an Input, an output or an event of a **DDS** device, in any of the screens in GE_POWER.

- **IdObject**: Identify the object

- The field **Identification** is an index addressed to the table "STATUS", "INPUTS_OUTPUTS" or "EVENTS" where the status, the Input/Output or the Event associated is described. The description it will depend on the type of object.

- The field **Type** identify the type of Object (STATUS, INPUT_OUTPUT, EVENT) associated to the Object Bistable.

- The fields containing the BMP files associated to the different status are: **ActivePicture**, for the active picture, **NonActivePicture** for the non active picture, and **NonPresencePicture** that is the name of the file that represent the non presence of the bay where the element associated to the object is.

- In the fields **X** and **Y** are stored the horizontal and vertical axis where the object is in reference with the GE_POWER screen.

- The field **Screen** will be coincident with **IdScreen** of the table SCREENS corresponding to the GE_POWER screen where the object is being represented.

- **Scale** will be the scale factor that is applied in the picture to represent it on the screen.

11.4.8 TABLE OBJ_SWITCHGEAR_ALPS

The table "Obj_Switchgear_ALPS" start from the Switchgear of the relay model **ALPS** in the Substation (described in the table "SWTICHGEAR_ALPS". To all the Switchgear of this table that we want to manage as graphical objects (in order to be represented on the screen of the GE_POWER), we need to add certain characteristics in order to have an adequate performance.

A Graphical Object (type Switchgear) is represented on the screen with a pictures (or .BMP files). Each picture corresponds to one status of the Switchgear.

The different fields of the table are as follows:

- The field **IdObject** identifies the object in the Substation.

- The field **Identification** relates the Object Switchgear with the corresponding Switchgear. The value of this field is equal to the field **Identification** in the table "SWTCHGEAR_ALPS" described before.

- The fields corresponding to the different pictures associated with the Switchgear status will be of type text. They will include the name of the corresponding BMP file. They are as follows: **PictureON** (correspond to the file name that contain the picture representing the status "ON"), **PictureOFF** (file that contain the picture representing the status "OFF"), and finally **NonPresencePicture** (correspond to the file name that contain a picture representing the non presence of the bay where the Object is).

- In the fields **X** and **Y** are stored the horizontal and vertical axis where the object is in reference with the GE_POWER screen.

- The field **Screen** will coincide with **IdScreen** of the table SCREENS corresponding to the GE_POWER screen where the object is being displayed.

- **Scale** will be the scale factor that is applied to the picture when displayed on the screen.

- The flag **Operational** indicates if we can command an operation over a Switchgear object from the GE_POWER.

- The fields **IdTextOperation1** and **IdTextOperation2** are the indexes in the table DEFAULT_TEXT where we can find the texts associated with the two operations related to the Switchgear.

The table "Obj_Alarm_ALPS" contains the alarms from **ALPS** relays, which will be displayed as graphical objects. They are associated to elements in the table PANEL_ALPS. The Alarms are displayed as buttons, which can be associated either to a BMP file or to a text that will indicate the different alarm statuses. They can also blinking according with its status.

- **IdObject** identifies the Object in the Substation.

- The field **Identification** will be equal to **Identification** of the table "EVENTS" where is described the Event associated to this graphical Object.

- The fields corresponding to the different pictures associated with the alarm status are of text type. They include the file name of the corresponding .BMP file. They are: **PictureActiveAcknowledged, PictureNonActiveNonAcknowledged, PictureActiveNonAcknowledged, PictureNonActiveAcknowledged. PictureNonPresent** will be the name of the file that contains the picture that represents the non-presence status of the bay where the object is.

- The following fields indicate whether the Object must blink or not for each of the statuses: **BlinkingActiveNonAckwonledged, BlinkingActiveAcknowledged, BlinkingNonActiveAcknowledged, BlinkingNonActiveNonAcknowledged.**

- Fields **X** and **Y** store the horizontal and vertical axis where the object is in the GE_POWER screen.

- The field **Screen** will coincide with **IdScreen** of the table SCREENS corresponding to the GE_POWER screen where the object is displayed.

- Scale will be the scale factor that is applied to the picture when displayed.

The table "Obj_Operation_ALPS" contains the Operations of the **ALPS** relays associated to the elements of the table "OPERATIONS". A button graphically represents these objects where a picture can be associated. Its characteristics are defined in the following fields:

- **IdObject** identifies the Object in the Substation.

- **Identification** is an index to the table "OPERATIONS" where the associated operation is described.

- The field **TextOperation** contains the text corresponding to the operation in the table "OPERATIONS".

- Fields **X** and **Y** store the horizontal and vertical axis where the object is in the GE_POWER screen.

- The field **Screen** will coincide with **IdScreen** of the table SCREENS corresponding to the GE_POWER screen where the object is being displayed.

- The field **Picture** is the file name of the picture embedded in the, and the field **Text** contains the text that appears in the button .

- **Font** indicates the text font, and **FontSize** is the font size of the letter applied.

- **WidthButton** and **HeigthButton** correspond to the size (in twips) of the Width and Height of the button. These sizes will be used to define the button size, in case a picture is associated. In case there is a text associated to this button, these fields are ignored.

11.4.11   TABLE OBJ_MEASURE_ALPS

The table Obj_Measure_ALPS describes the different graphical objects associated to measures from **ALPS** relays that can be viewed in GE_POWER. These values come from table MEASURES_ALPS. They are text that represent the current value of the associated measure. The fields defining theirs characteristics are:

- **IdObject** identifies the Object measure in the Substation

- **Identification** is an index to the table "MEASURES" where the associated measure is described.

- The fields that describe the characteristics of the text are **Font** (Type of letter of the measure and **Size** (font size).

- The field **ScalePresentation** contains the scale factor that will be applied over the measure before being displayed in the screen by GE_POWER.

- The number of decimal digits that appear on the screen is defined in **DecimalNumber**.

- Fields **X** and **Y** store the horizontal and vertical axis where the object is in the GE_POWER screen.

- The field **Screen** will coincide with **IdScreen** of the table SCREENS corresponding to the GE_POWER screen where the object is being displayed.

- The Text that represents the value of the measure can change its color depending on the value. This way, **Colorband1** is the color when the value is lower than LimitBand12, **ColorBand2** is de color when the value is lower than LimitBand23, **ColorBand3** is the color when the value is lower than LimitBand34 and **ColorBand4** is the color when the value is higher than LimitBand34.

- The fields **LimitBand12**, **LimitBnad23** and **LimitBand34** are used to determine the limits between the different bands, and so apply the colors depending on the value of the measure.

11.4.12   TABLE OBJ_BISTABLE_ALPS

The objects of this table can present two status (ON, OFF) and a third one associated to the condition of non presence of the associated bay where the element is. They are used to represent a status, an Input, an output or an event of a **ALPS** relay, in any of the screens in GE_POWER.

- **IdObject** : Identifies the object

- The field **Identification** is an index to the table "STATUS", "INPUTS_OUTPUTS" or "EVENTS" where the status, the Input/Output or the Event associated is described. The description will depend on the type of object.

- The field **Type** identifies the type of Object (STATUS, INPUT_OUTPUT, EVENT) associated to the Object Bistable.

- The fields containing the BMP files associated to the different statuses are: **ActivePicture**, for the active picture, **NonActivePicture** for the non active picture, and **NonPresencePicture** that is the name of the file that represents the lack of the bay where the element associated to the object is.

- Fields **X** and **Y** store the horizontal and vertical axis where the object is in the GE_POWER screen.

- The field **Screen** will coincide with **IdScreen** of the table SCREENS corresponding to the GE_POWER screen where the object is being displayed.

- **Scale** will be the scale factor that is applied in the picture to represent it on the screen.

11.4.13   TABLE OBJ_PRESENCE

This table registers the Objects associated to the statuses Presence and non-Presence of each bay in the Substation.

- **IdObject** identifies the object.

- **IdBay** is the index to the table "BAYS", indicating the bay related to this Object.

- The fields containing the BMP files associated to the different statuses are: **PresentPicture**, for the picture in Present status (indicating that the associated bay is communicating in that moment), and **NonPresentPicture** for the non present status, indicating that the associated bay has stopped communicating for any reason.

- Fields **X** and **Y** store the horizontal and vertical axis where the object is in the GE_POWER screen.

- The field **Screen** will coincide with **IdScreen** of the table SCREENS corresponding to the GE_POWER screen where the object is being represented.

11.4.14   TABLE OBJ_GOTO

This table stores Objects Goto. These Objects are represented graphically by a button associated to a picture. When the button is clicked, the active screen in GE_POWER changes to the one indicated in the field Goto. The fields to define are as follows:

- **IdObject** identifies the Object.

- **Bitmap** is the name of the file that contains the BMP picture associated to the button Goto.

- Fields **X** and **Y** store the horizontal and vertical axis where the object is in the GE_POWER screen.

- The field **Screen** will be coincide with **IdScreen** of the table SCREENS corresponding to the GE_POWER screen where the object is being represented.

- The field **Goto** will be coincide the **IdScreen** of the table SCREENS corresponding to the GE_POWER screen that becomes active when the button Goto is clicked.

11.4.15   TABLE OBJ_PROGRAM

The table "Obj-Program" defines some Objects type button that will be used to run a program when they are clicked on.

- **IdObject** identifies the Object.

- **Bitmap** is the name of the file that contains the BMP picture associated to the button Program.

- Fields **X** and **Y** store the horizontal and vertical axis where the object is in the GE_POWER screen.

- The field **Screen** will coincide with **IdScreen** of the table SCREENS corresponding to the GE_POWER screen where the object is being displayed.

- The field **Program** stores the path and the file name of the file that will be run when the corresponding button is clicked. In **File** we can indicate the path and file name that the program will use.

11.4.16   TABLE OBJ_TEXT

The table "Obj_Text" contains Objects used to represent text in any screen of GE_POWER. They are not associated to any active element. They are static Objects. Their characteristics are defined in the following fields:

- **IdObject** identifies the Object text in the Substation.

- The field **Text** contains the text that is displayed on the screen and **Size** the size.

- **Font** is the font type of the letter used.

- **Bold** indicates if the field will be represented in bold or not and **Underlined** if the text is or not underlined.

- **Color** will be the color for the letter.

- Fields **X** and **Y** store the horizontal and vertical axis where the object is in the GE_POWER screen.

- The field **Screen** will coincide with **IdScreen** of the table SCREENS corresponding to the GE_POWER screen where the object is being displayed.

11.4.17   TABLE OBJ_TEXTROT

The table "Obj_Text_Rot" contains Objects used to represent text in any screen of GE_POWER. They are not associated to any active element. They are static Objects. Their difference with the Obj_Text is that we can define an angle to rotate this object. Their characteristics are defined in the following fields:

- **IdObject** identifies the Object text in the Substation.

- The field **Text** contains the text that is displayed on the screen and **Size** the size.

- **Font** is the font type of the letter used.

- **Bold** indicates if the field will be displayed in bold or not and **Underlined** if the text is or not underlined.

- **Color** will be the color for the letter.

- Fields **X** and **Y** store the horizontal and vertical axis where the object is in the GE_POWER screen.

- The field **Screen** will coincide with **IdScreen** of the table SCREENS corresponding to the GE_POWER screen where the object is being displayed.

- The field **Angle** indicates the rotation angle, where the **X** axis is the reference.

- **Width** and **Height** are the dimensions of the box that contains the text.