GECO: USER MANUAL

Code: GECO/TEC/001

Issue: 1.J

Date: 18/02/2021

Number of pages: 164

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Document Distribution List:

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Acronyms:

ARB **A**nomaly **R**eview **B**oard

CD **C**onceptual **D**esign

CRB **C**onfiguration change **R**eview **B**oard

DD **D**etailed **D**esign

MTBF **M**ean Time **B**etween **F**ailures

MTTF **M**ean **T**ime **T**o **F**ailure

MTTR **M**ean **T**ime **T**o **R**epair

NRB **N**on-conformity **R**eview **B**oard

PD **P**reliminary **D**esign

PRD **PR**oDuction **P**hase

PT **P**roduct **T**ree

RAMS **R**eliability, **A**vailability, **M**aintainability, **S**afety

XML e**X**tensible **M**arkup **L**anguage

Change Control

Issue	Date	Section	Page	Change Description
1.A	15/02/08	All	All	First issue
1.B	14/06/11	3.3 16.5	19 158	Second issue: - GECO configuration file section added. - Delete users.
1.C	27/06/12	 3.2 3.3 18	 16 19 161	Third issue: - New fields in the user installation wizard. - A clarification note added (Note 1) - The documents codification conventions are clarified.
1.D	09/11/13	 3.1 5.6 6.2 6.6 7.2 7.6 8.2 9.3 9.6	 16 35 37 44 45 52 54 70 74	Forth issue: - Supported Java 1.7 - Added new functionality “Export PT elements to XLS” - Change the length of comment field in Part form - Added new functionality “Export Parts to XLS” - Change the length of description field in Interface form. - Added new functionality “Export Interfaces to XLS” - Added the possibility of change the requirement code. - Added new fields to verification matrix form. - Added new functionality “Verification Matrix Summary View”
1.E	25/07/14	 8.7 9.2 9.6 9.7	 65 69 74 75	Fifth issue: - Add new functionality to export the requirement’s children search to xls. - Add the possibility to insert the requirements in the verification matrix by searching by requirement document. - Add the possibility to search by requirement document in the verification matrix summary view. - Add the possibility to search by requirement document in the export verification matrix to xls.
1.F	10/09/18	 3.1 3.2 4.4	 16 16 26	Sixth issue: - Supported Java 8.0 - New instructions to launch the GECO tool - New section: Update GECO

		12.1	105	- Add new non-conformity status: "Obsolete".
1.G	27/03/19	 8.8 8.9	 67 68	Seventh issue: - New section: Export requirements to XLS - New section: Import requirements from XLS
1.H	11/01/19	9.8	76	Eighth issue: - New section: Import verification matrix from XLS
1.I	20/01/21	 8 14 15	 54 131 142	Ninth issue: - Add new field in the requirement form: "Auxiliary file" - New section: RAMS components for reparable system. - New section: RAMS components for system without repair - General typo corrections
1.J	18/02/21	3.2 3.2.1		Section 3.2 removed (this section will be included in a new document). Section 3.2.1 removed (this section will be included in a new document).

Reference Documents

N#	Document Name	Code

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1. SUMMARY

This is the User Manual of Fractal **GE**neral **CO**nfiguration Management Tool (GECO).

In this manual, you will learn:

- GECO functionality
- How to use the application step by step and
- How to handle the problems that could arise.

2. GECO OVERVIEW

The goal of GECO is twofold: firstly, to assist the System Engineering Group to control and maintain the configuration items of a system, both in the development phase and in the operation and maintenance phase; secondly, to make this information available to the other groups within the organization or the consortium in charge of developing and operating the System.

Developing a proper System Engineering Plan is a distinctive advantage for leading a project to success. During the implementation of such plan, the system configuration data are generated: Product Tree (PT) elements, requirements, interfaces, specification documents, procedures, reports, etc. The amount of information keeps growing in size and complexity along the project's lifetime, to such an extent that it becomes virtually impossible to manage all that information without the aid of specific computer-based tools.

Specifically, the system information that can be stored and controlled through this tool is:

- The Product Tree elements and the parts
- The table of interfaces.
- The requirements, interface requirements and the relationships between parent and child requirements.
- The requirement verification matrix
- The configuration changes
- Non-conformities
- Verification and operation anomalies
- The project documentation, i.e. specification documents (at the system and subsystem level); interface specification documents; tests, analysis and assessment documents; etc.

2.1 GECO Functionality: A quick look

The configuration information is hierarchically distributed following the Product Tree of the system. This provides an intuitive view of the system's breakdown structure, and thus allows the user to access, with a few mouse clicks, to a Product Tree element, its requirements, interfaces, associated documents, etc.

Each Product Tree element shall have a code that identifies it uniquely. Using a consistent, manageable coding convention is paramount, as this code shall be the base for assigning codes to the rest of the configuration items: documents, requirements, interfaces, etc. The user defines the PT element code, and then the Configuration Management Tool shall generate automatically the codes of the remaining configuration items; the user can either accept or modify such codes, but the tool shall check that the codes are not duplicated or inconsistent.

The General Configuration Management Tool provides the following functionalities, which we describe as displayed in the tool corresponding to the different folders on the top bar (underscored and bolt letter is used to press on the keyboard to execute the command):

- **File** utilities: the commands included here are:
  - **P**rint view, for printing the selected view
  - **E**xit for closing the tool
- **Views:** the Data Views screens (see section 4.2) allow the user to visualize as a table all the relevant information stored for a PT element. Once a PT element is selected on the screen, the following views are available:
  - **A**nomalies View
  - **C**onfiguration changes View
  - **D**ocumentation View
  - PT **e**lements View
  - **I**nterfaces View
  - **N**on-conformities View
  - **P**arts View
  - RAMS components View for Repairable Systems
  - RAMS components View for Systems without Repair
  - **R**equirements View
  - **V**erification matrix View
- **Forms**: Data input form screens provide forms for adding or modifying the data associated to each configuration item. Once a PT element is selected, any of the forms described below can be opened. The form provides access to all the records associated to the element, and allows the user to search or filter information based on the fields contained in the specific form.
  - **A**nomalies Form (see section 13): this form allows the user to start new anomalies or to add information to the already existing ones. As in the case of configuration changes and non-conformities, the tool shall send notifications to the users in charge of the anomaly.
  - **C**onfiguration changes Form (see section 11): it allows the user to start new configuration changes and to add information to the changes that already are in course (conducted actions, changes of status, affected documents, etc.). The

process associated to the configuration changes may range from very simple (when the change considered does not affect other elements of the system) to rather complex (when other elements or different working groups are involved). In any case, the application helps to coordinate this process by sending the necessary notifications to the users affected by the change, as the configuration change goes through its lifecycle (approved, rejected or finalized), i.e. it guides the user through the lifecycle defined for a configuration change.

- **D**ocumentation Form (see section 10): this form allows the user to enter or to modify the documents associated to the project by connecting them with PT elements. They may be requirement specification documents, analyses, reports, procedures, etc. It is essential that the Configuration Management Tool contains the project documents, or at least it can link them from another database, as the requirements are usually traced to documents (analysis documents, reports, etc.) that contain the rationale for the requirement, and therefore they help to understand the consequences of a configuration change.

- PT **e**lements Form (see section 5): where the definition of the elements of the PT can be introduced and be modified, for example the related documents, etc.

- **I**nterfaces Form (see section 7): this form allows the user to define and to modify the interfaces among the PT elements, thus showing which elements are related to each other.

- **N**on-conformities Form (see section 12): this form allows the user to start a new Non-conformity, as well as to add new bits of information to the already existing non-conformities. As in the case of the configuration changes, the tool sends notifications to the users affected by the Non-conformity as it goes through its lifecycle (approved, rejected or fixed), i.e. it guides the user through the lifecycle defined for a Non-conformity.

- **P**arts Form (see section 6): where the definition of the Parts can be introduced and modified (for example the related documents, etc.)

- **R**equirements Form (see section 8): this form allows the user to enter new requirements, or to modify the already existing requirements, associated to a certain PT element. A major functionality of this form is the ability to track down this requirement to other requirements or to documents, what is crucial for identifying what a configuration change or a non-conformity actually involves. This utility is used for assessing the impact of the proposed change in terms of scope, schedule and price, and it is one of the major goals of the Configuration Management Tool.

- RAMS Form for Repairable System (see sections 14): this form allows the user to create or modify RAMS components and their relationships. RAMS components are not necessarily linked to PT elements. The functionality of this form is to calculate the mean time between failures (MTBF) and the mean time to repair or MTTR, as well as the system availability (or the opposite concept, unavailability/downtime) of the set of components and subsystems created with the tool.

- RAMS Form for Systems without Repair (see sections 15): this form allows the user to create or modify RAMS components and their relationships. RAMS components are not necessarily linked to PT elements. The functionality of this

form is to calculate the time up to the first failure, MTTF, or operation time, as well as the system reliability (or the opposite concept, unreliability/probability of failure) of the set of components and subsystems created with the tool.

- **U**sers Form (see section 15): this form allows the administrator to enter or to modify the users authorized in the system.
- **V**erification matrix Form (see section 9): this form allows the user to enter and to modify the results of the verification tests.

❖ **Tools:** The Configuration Management Tool provides a set of built-in utilities that are described below:

- Consult requirement's children (see section 8.7): the tool shall display the requirements that are affected by a change in a higher level requirement. To do so, the parent-child relationships (traceability) that were introduced in the Requirements Form are considered.
- Consult requirement's parents (see section 8.6): the tool shall display the requirements that are affected by a change in a lower level requirement.
- Export requirements to XML (see section 10.6): Automatic generation of the requirements document: the tool gathers the requirements of the selected PT element and then generates the document section where the requirements are specified; such section can be imported into the definitive formal specification document, as it is described in the corresponding chapter. The format of the generated document section is XML.
- Export interfaces to XLS (see section 7.6): all the interfaces of one subsystem and lower level elements will be exported to an XLS document.
- Export PT elements to XLS (see section 5.6): all the PT elements of one subsystem and lower level elements will be exported to an XLS document.
- Export parts to XLS (see section 6.6): all the parts of one subsystem and lower level elements will be exported to an XLS document.
- Export Verification Matrix to XLS (see section 9.7): all the verification matrix elements of one subsystem and lower level elements or of a document will be exported to an XLS document.
- Import Verification Matrix from XLS (see section 9.8): all the verification matrix elements of the selected subsystem (and its lower level elements) or of the selected requirement document, will be imported to the application from an XLS document.
- Export RAMS (repairable systems) calculations to XLS (see section 14.6): all the RAMS components of one subsystem and lower level elements will be exported to a XLS document.
- Export RAMS (systems without repair) calculations to XLS (see section 15.6): all the RAMS components of one subsystem and lower level elements will be exported to a XLS document.
- Export requirements to XLS (see section 8.8): all the requirements of a document will be exported to an XLS document.

- Import requirements from XLS (see section 8.9): the requirement of a document will be imported to the application from an XLS document.
- Filter data (see section 4.2.3): this allows the user to search or filter information based on the fields contained in the specific form or view.
- Insert requirements into the Verification matrix automatically (see section 9.2): all the technical requirement of one subsystem can be automatically introduced in the verification matrix when the user decides that such subsystem is ready for being verified.
- Verification Matrix summary view (see section 9.6): a summary view of the verification matrix elements of one subsystem and lower level elements will be exported to a pdf document.

The General Configuration Management Tool contains a database and a user-friendly graphical interface. The application uses a commonly used database, whereas the user interface is developed in Java, what makes it platform independent, i.e. it runs on Unix, Linux and MS-Windows operating systems.

- **Help**: to give support while using GECO.
  - About contains the application description
  - User manual contains this manual in PDF format

3. INSTALLING GECO

3.1 Software requirements

The minimum software requirements to install GECO on your computer are the following:

- Windows XP/Vista or Linux 2.4 or greater
- The Java Runtime Environment 8.0 or greater

(For more information to download and install Java Runtime Environment and MySQL Server see the page http://www.fractal-es.com/en/GECO.html)

3.2 GECO Installation

After the GECO software is downloaded and unzipped in your machine, launch GECO following the instructions in the file README-GECO.txt.

Once the installation wizard is executed:

1. The following license dialog will appear

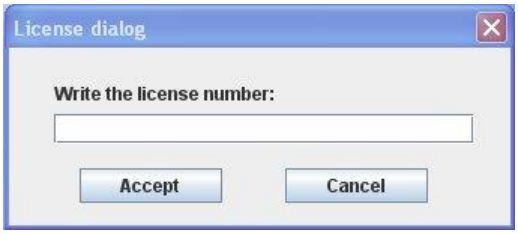


Figure 1: *GECO License dialog*

⇒ Introduce the *license number*,

⇒ click *Accept*,

If the license number is not correct, the installation will be cancelled and the following dialog appears:

Figure 2: *GECO license Error dialog*

2. Once the license number is accepted, the following working dir dialog will be opened

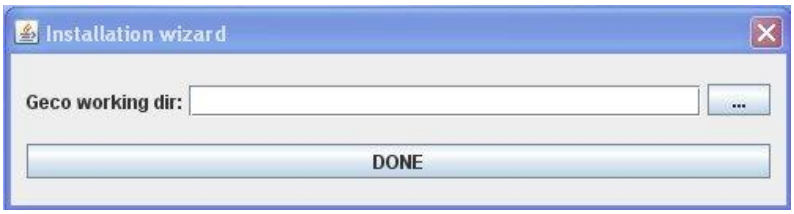


Figure 3: *GECO Working dir dialog*

⇒ Introduce GECO *working dir* or select it from an Open dialog by clicking the **…** button,

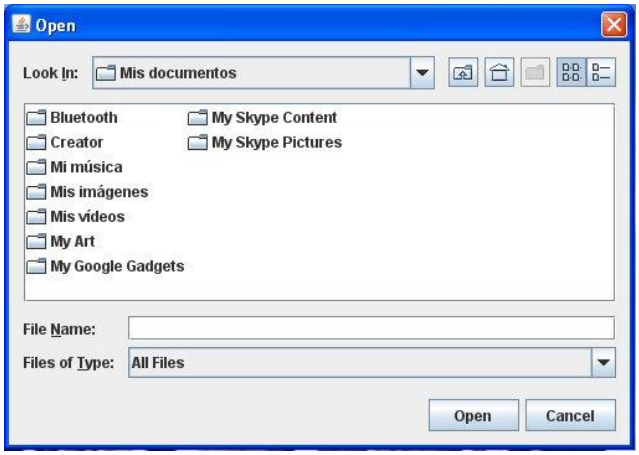


Figure 4: *Open dir dialog*

⇒ click *Accept*

3. The wizard will open the following GECO configuration wizard dialog.

Figure 5: *GECO configuration wizard dialog*

⇒ Select the *User* option,

⇒ Click *Continue*.

4. The wizard will open GECO configuration wizard: Step 1 dialog, where the information about GECO server name (networking name or IP) and MySQL port must be introduced.

Figure 6: *GECO configuration wizard Step 1 dialog*

⇒ Introduce GECO *server name*,

⇒ Introduce the *MySQL port*,

⇒ Introduce the *MySQL database name*,

⇒ Introduce the *MySQL database write username*,

⇒ Introduce the *MySQL database write user password*

⇒ Introduce the *MySQL database read username*,

⇒ Introduce the *MySQL database read user password*,

⇒ Click *Continue*.

The wizard will configure GECO application according to the introduced data.

5. The wizard will open the following GECO configuration wizard: Step 2 dialog, where the information that the application needs to send e-mails to GECO users must be introduced.

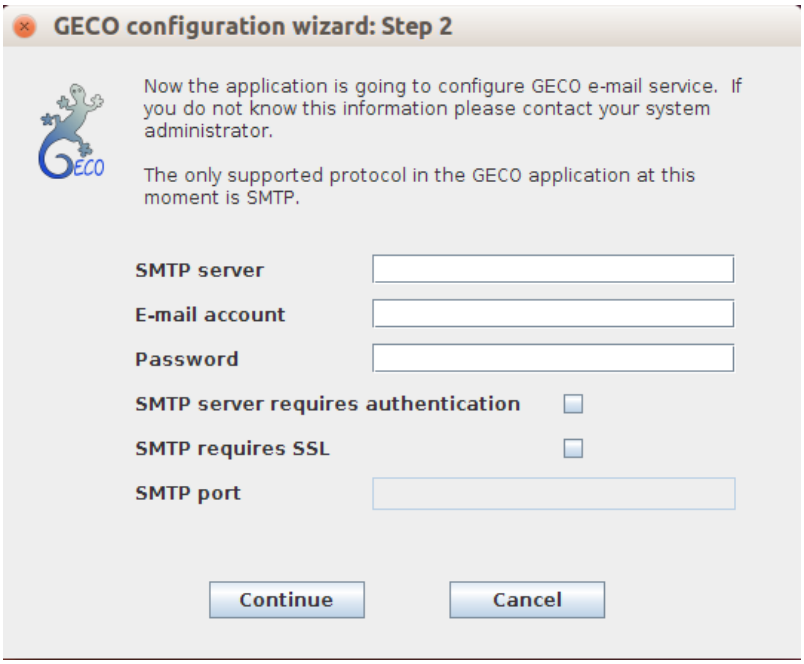


Figure 7: *GECO configuration wizard Step 2 dialog*

⇒ Introduce the SMTP *server name*,

⇒ Introduce the *e-mail account* (account created to send GECO e-mails, for example name@company.com),

⇒ Introduce the e-mail account *password*,

⇒ If the SMTP server needs authentication, select the checkbox *Authentication required by the server*,

⇒ If the SMTP server requires SSL, select the checkbox *SMTP requires SSL*,

⇒ If the SMTP server requires SSL, introduce the SMTP port,

⇒ Click *Continue*.

6. The wizard will finish GECO installation and will start GECO application.

3.3 GECO configuration file

The file geco.props is the GECO configuration file.

The parameter to configure are (the file path is *$GECO_WOKRDIR/geco.props*):

- *mySQLPort* -> MySQL port (for example 3306).

```
mySQLPort=3306
```

- *mySQLHost* -> MySQL host name (for example localhost).

```
mySQLHost=localhost
```

- *dbName* -> MySQL database name (by default geco).

```
dbName=geco
```

- *userAdmin* -> It's the database MySQL user with the needs rights to can read/write the database.

```
userAdmin=USERADMIN
```

- *userRead* -> It's the database MySQL user with only read rights in the database.

```
userRead=USERREAD
```

- *passwordAdmin* -> It's the database MySQL userAdmin password.

```
passwordAdmin=USERADMINPASSWORD
```

- *passwordRead*-> -> It's the database MySQL userRead password.

```
passwordRead=USERREADPASSWORD
```

- *keyword*-> -> It's the keyword licence.

```
keyword=KEYWORD
```

- *mail.smtp.host* -> Mail SMTP Host name of the company (for example mail.fractal-es.com).

```
mail.smtp.host=mail.fractal-es.com
```

- *mail.smtp.auth* -> TRUE if the SMTP Mail Server need authentication, FALSE if not.

```
mail.smtp.auth=TRUE
```

- *mail.smtp.user* -> e-mail user to manage the GECO e-mail service (for example docma@company.com).

```
mail.smtp.user=docma@company.com
```

- *mail.smtp.password* -> e-mail user password to manage the GECO e-mail service.

```
mail.smtp.password=password
```

- *mail.from* -> e-mail user to manage the GECO e-mail service (for example docma@company.com).

```
mail.from=docma@company.com
```

In the case the mail SMTP server is secure (SSL), you have these others parameters:

- *mail.smtp.port* -> Mail SMTP port (for example 465).

```
mail.smtp.port=465
```

- *mail.smtp.socketFactory.por* -> Mail SMTP socketFactory port (for example 465). It is the same that in the paremeter *mail.smtp.port.*

```
mail.smtp.socketFactory.port=465
```

- *mail.smtp.socketFactory.class* -> Mail SMTP socketFactory class. The value for this parameter has to be **javax.net.ssl.SSLSocketFactory**.

```
mail.smtp.socketFactory.class=javax.net.ssl.SSLSocketFactory
```

Note: If you change the user and/or password of the generic userAdmin and userRead users in the MySQL server, you have to change the username and/or the password values in the geco.props parameter *userAdmin/userRead* and/or *passwordAdmin/paswordAdmin*.

Note 1: If you change the database name in the MySQL server, you have to change the *dbName* value in the geco.props parameter *dbName*.

4. STARTING GECO

4.1 Logging into GECO

Once GECO is executed (see 3.2), the following Login window will appear:

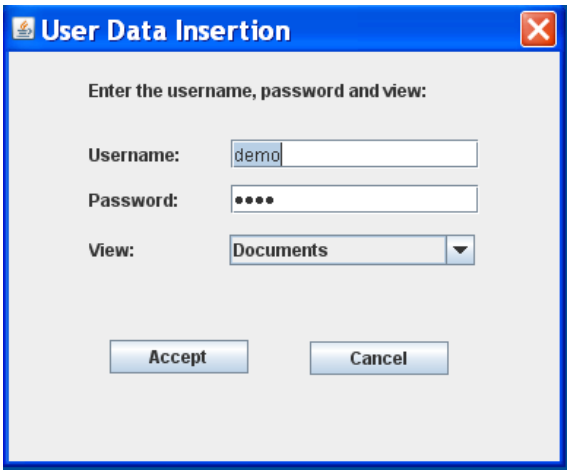


Figure 8: *GECO. Login window*

⇒ Introduce the *Username*,

⇒ Introduce the *Password*,

⇒ Select in the *View combo box* which view is going to be displayed whenever the logging in is successful (by default, the *Documents View* is selected).

⇒ click *Accept*,

If the login information is correct, the Main window will be opened.

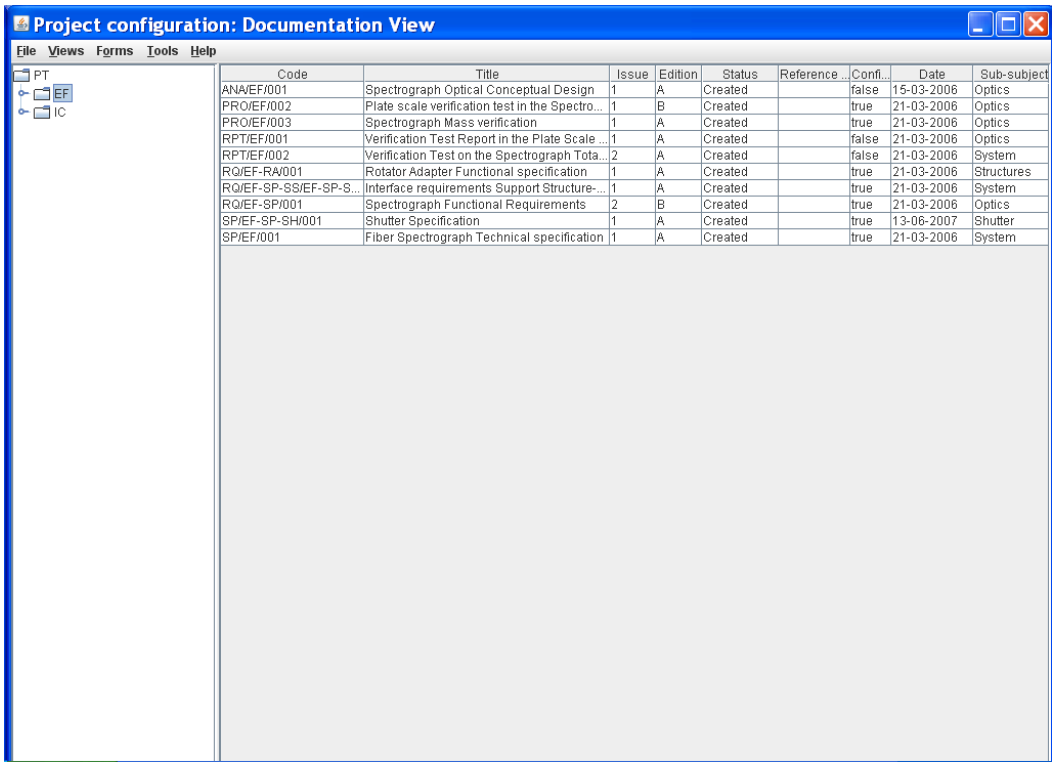


Figure 9: *Documentation View (Default view) and main menu*

The User could either modify the data and enter new data or only read the current one according to the rights assigned to him/her.

4.2 Accessing the data

As it was described in the overview of the application (section 2), all the data are hierarchically distributed following the Product Tree of the systems. It allows the user to find quickly all the information existing in GECO associated with a particular Product Tree Element.

4.2.1 Changing Views

In the Main window application, the different views can be changed by selecting Views *Menu* $\Rightarrow$ *xxxx View* or pressing *ALT+V+x*.

Where, *xxxx* can be any of the following:

- Anomalies (*x: A*)
- Configuration changes (*x: C*)
- Documentation (*x: D*)
- Product Tree elements (*x: E*)
- Interfaces (*x: I*)
- No-conformities (*x: N*)

- Parts (*x: P*)
- RAMS Components of Repairable Systems
- RAMS Components of Systems without Repair
- Requirements (*x: R*)
- Verification Matrix (*x: V*)

Whenever the view is changed, the Product Tree element selection comes back to the highest-level element of the tree.

Therefore, all records existing in GECO corresponding with the selected view will be displayed in the left part of the application.

4.2.2 Moving through the PT elements

In the Main window application, select a Product Tree element by clicking the desired element with the left button of the mouse.

The selected Product Tree element will be highlighted.

All records corresponding to the view previously selected and belonging to this Product Tree element (and, also, to the low-level Product Tree elements under the selected one) will be displayed in the left part of the application.

Those elements with lower level subsystems in the PT appear with a symbol (like a key). The horizontal / closed position indicates that the low-level subsystems exist but they are not currently shown while the vertical / open position indicates that the subsystems are being shown.

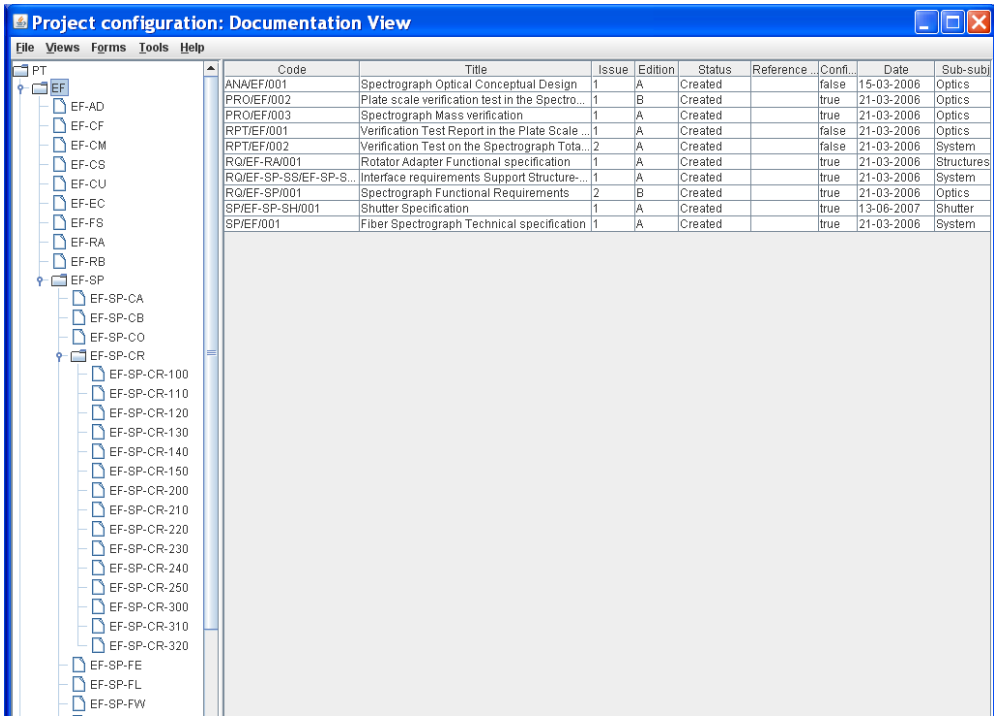


Figure 10: *Selected PT element (left) and its corresponding view shown at the right*

4.2.3 Filtering the data

The number of records to be displayed can be constrained by using the filtering option.

In order to filter the records, in the Main window of the application, select *Tools* Menu ⇒ *Filter table …* or press *ALT+T+F*.

A new window will appear,

⇒ Select in the *Field combo box* the desired field to filter the data. All the fields of the corresponding view will be displayed in the combo box.

⇒ Write in the *Value* text field the text that is going to be used to filter the previously selected field step, (upper and lower cases are not distinguished).

⇒ Define as many filters as wanted (by adding new lines),

⇒ Click *Accept*,

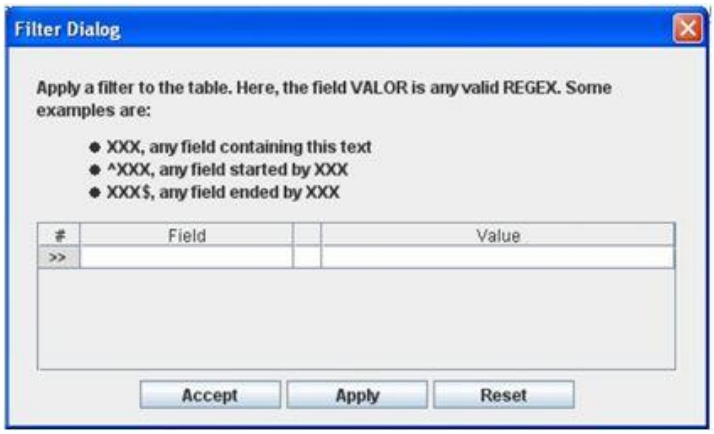


Figure 11: *Filter Dialog. Any field can be selected for any value*

In the Main window, the records displayed will have been filtered according to the criteria selected in the filter window.

4.2.4 Printing the data

The current view (i.e., the records that are currently displayed) can be printed using the printing option.

In order to print the records, in the Main window of the application, select *File Menu* ⇒ *Print* view or press *ALT+F+P*. The application will look for the printers connected to your computer and the print menu will be opened.

A new window will appear,

⇒ select in the *Name combo box* the printer to be used,

⇒ define the desired properties for this job,

⇒ click *Accept*,

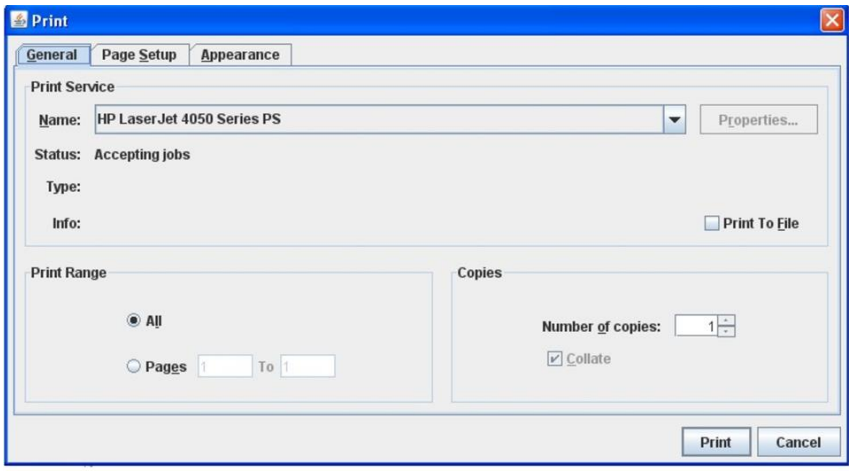


Figure 12: *Print Dialog. The selected fields at the right panel of the tool will be printed*

4.2.5 Editing the data

In order to edit the data, the corresponding Form View of the record to be modified must be opened (see sections from 5 to 14 for a detailed explanation).

Whenever editing the data in the Forms, you have to take into account that:

> The mouse cannot be used to copy or paste the fields, but to select part of the text inside a field. Then you can use the DEL key to delete the selected text. Also, you can use the key CTRL+C to copy a field and CTRL-V to paste a field.

4.3 Exit from GECO

In the Main window, select *File* Menu ⇒ *Exit* or press *ALT+F+E*.

The application will end.

4.4 Update GECO

Each time that the tool is launched it will connect to the Fractal server to check if there is a new version of GECO tool. If there is the case, a new window will appear,

⇒ The user can follow the instructions to update the tool and click *OK*, or

⇒ Click *Cancel* and launch the GECO tool without update it (it is not the recommended option).

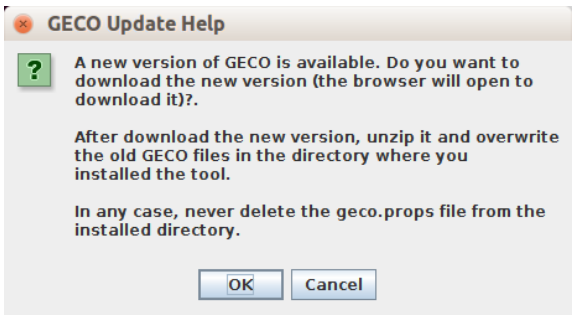


Figure 13: *GECO update Dialog*

5. PRODUCT TREE ELEMENTS

5.1 What is a Product Tree?

The product tree (PT, Product Tree) describes the hierarchic breaking up of a complex system into the necessary levels to be able to define the system completely. An example of a Product Tree is shown in the following figure:

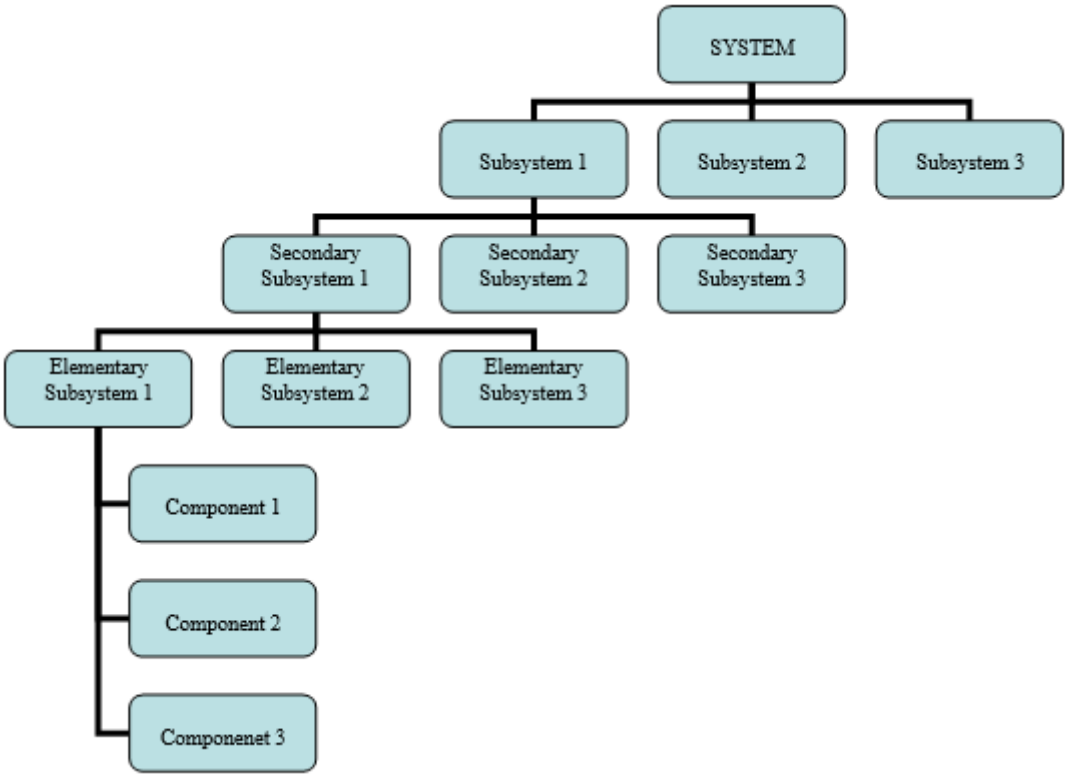


Figure 14: *Product Tree: a hierarchical organization of subsystems*

From the project point of view, the Product Tree provides a representation of the whole system and breaks the system up into the subsystem levels that are going to be designed and procured independently.

Each Product Tree element (i.e., system, subsystems or components) must be uniquely identified by a Product Tree element code. These codes can be used as a base to uniquely identify other elements of the project such as interfaces, requirements, documents, etc.

5.2 Creating a new Product Tree Element

Starting at the Main Window of the application,

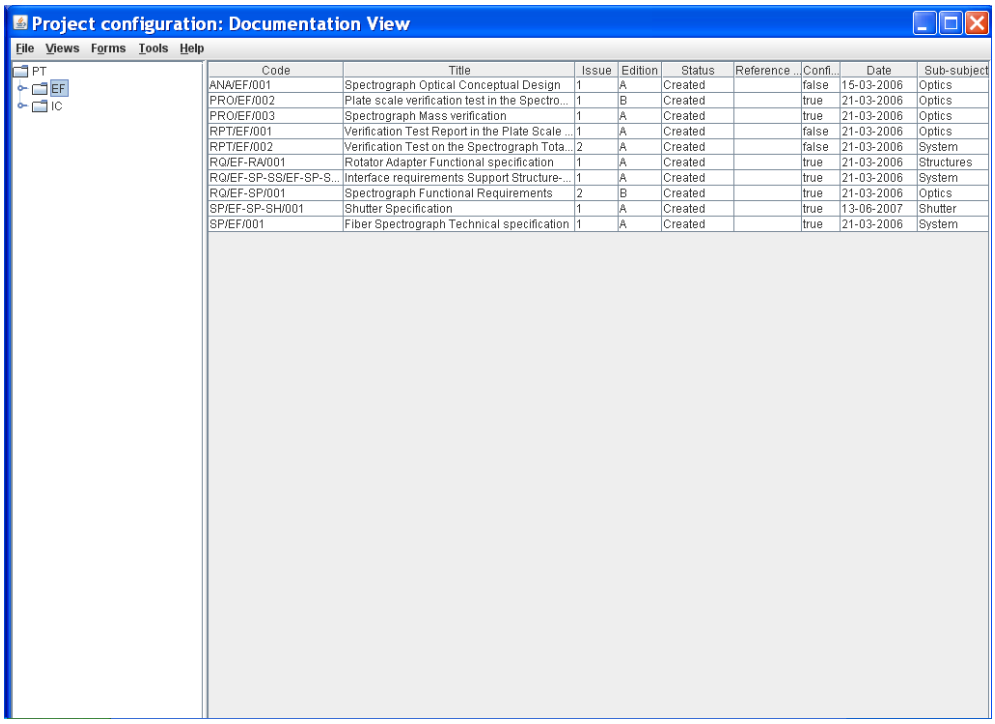


Figure 15: *Main window of the application*

The following steps must be executed in order to create a new Product Tree element:

A. Open the Configuration Elements Form.

In the Main window, the Product Tree elements Form can be opened in two different ways:

A.I. Going through the Forms Menu.

In the Main window, select *Forms Menu* ⇒ *PT elements Form* or press *ALT+O+E*.

The PT Elements Form will be opened with all available records selected.

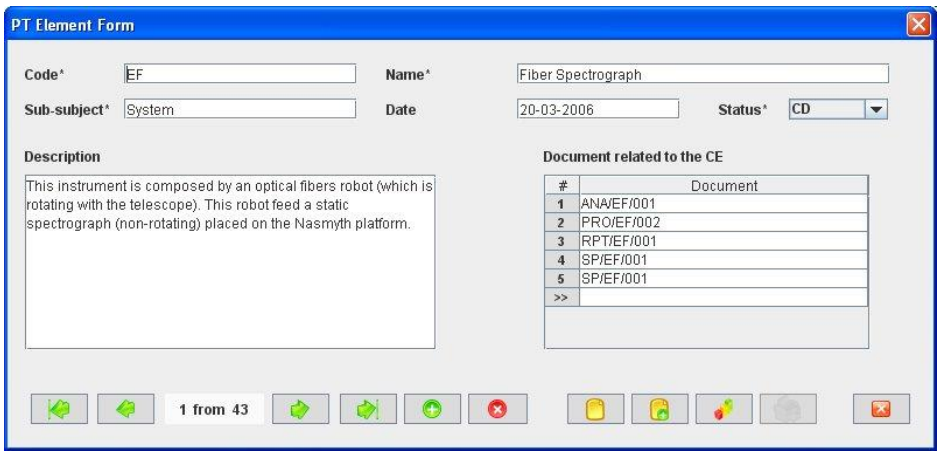
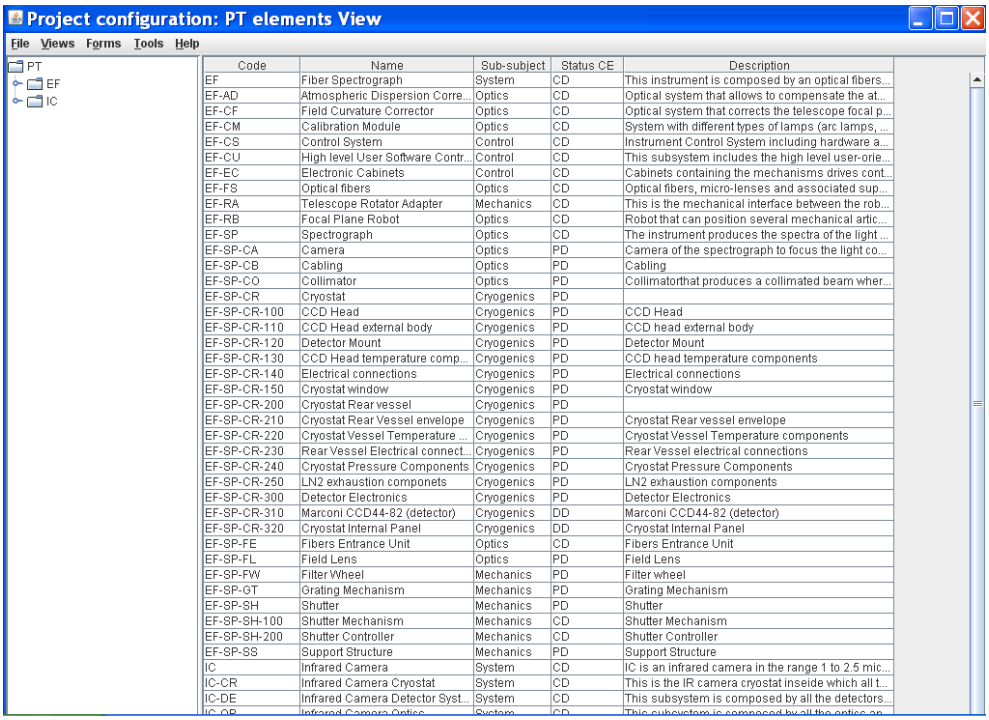


Figure 16: *PT Elements Form (with all records selected)*

A.II. Selecting a Product Tree element in the Product Tree elements View.

In the Main window, click the *Views Menu* ⇒ *PT elements View* or press *ALT+V+E*.



Code	Name	Sub-subject	Status CE	Description
EF	Fiber Spectrograph	System	CD	This instrument is composed by an optical fibers...
EF-AD	Atmospheric Dispersion Corre...	Optics	CD	Optical system that allows to compensate the at...
EF-CF	Field Curvature Corrector	Optics	CD	Optical system that corrects the telescope focal p...
EF-CM	Calibration Module	Optics	CD	System with different types of lamps (arc lamps, ...
EF-CS	Control System	Control	CD	Instrument Control System including hardware a...
EF-CU	High level User Software Contr...	Control	CD	This subsystem includes the high level user-orie...
EF-EC	Electronic Cabinets	Control	CD	Cabinets containing the mechanisms drives cont...
EF-FS	Optical fibers	Optics	CD	Optical fibers, micro-lenses and associated sup...
EF-RA	Telescope Rotator Adapter	Mechanics	CD	This is the mechanical interface between the rob...
EF-RB	Focal Plane Robot	Optics	CD	Robot that can position several mechanical artic...
EF-SP	Spectrograph	Optics	CD	The instrument produces the spectra of the light ...
EF-SP-CA	Camera	Optics	PD	Camera of the spectrograph to focus the light co...
EF-SP-CB	Cabling	Optics	PD	Cabling
EF-SP-CO	Collimator	Optics	PD	Collimatorthat produces a collimated beam wher...
EF-SP-CR	Cryostat	Cryogenics	PD	
EF-SP-CR-100	CCD Head	Cryogenics	PD	CCD Head
EF-SP-CR-110	CCD Head external body	Cryogenics	PD	CCD head external body
EF-SP-CR-120	Detector Mount	Cryogenics	PD	Detector Mount
EF-SP-CR-130	CCD Head temperature comp...	Cryogenics	PD	CCD head temperature components
EF-SP-CR-140	Electrical connections	Cryogenics	PD	Electrical connections
EF-SP-CR-150	Cryostat window	Cryogenics	PD	Cryostat window
EF-SP-CR-200	Cryostat Rear vessel	Cryogenics	PD	
EF-SP-CR-210	Cryostat Rear Vessel envelope	Cryogenics	PD	Cryostat Rear vessel envelope
EF-SP-CR-220	Cryostat Vessel Temperature ...	Cryogenics	PD	Cryostat Vessel Temperature components
EF-SP-CR-230	Rear Vessel Electrical connect...	Cryogenics	PD	Rear Vessel electrical connections
EF-SP-CR-240	Cryostat Pressure Components	Cryogenics	PD	Cryostat Pressure Components
EF-SP-CR-250	LN2 exhaustion componets	Cryogenics	PD	LN2 exhaustion components
EF-SP-CR-300	Detector Electronics	Cryogenics	PD	Detector Electronics
EF-SP-CR-310	Marconi CCD44-82 (detector)	Cryogenics	DD	Marconi CCD44-82 (detector)
EF-SP-CR-320	Cryostat Internal Panel	Cryogenics	DD	Cryostat Internal Panel
EF-SP-FE	Fibers Entrance Unit	Optics	CD	Fibers Entrance Unit
EF-SP-FL	Field Lens	Optics	PD	Field Lens
EF-SP-FW	Filter Wheel	Mechanics	PD	Filter wheel
EF-SP-GT	Grating Mechanism	Mechanics	PD	Grating Mechanism
EF-SP-SH	Shutter	Mechanics	PD	Shutter
EF-SP-SH-100	Shutter Mechanism	Mechanics	CD	Shutter Mechanism
EF-SP-SH-200	Shutter Controller	Mechanics	CD	Shutter Controller
EF-SP-SS	Support Structure	Mechanics	PD	Support Structure
IC	Infrared Camera	System	CD	IC is an infrared camera in the range 1 to 2.5 mic...
IC-CR	Infrared Camera Cryostat	System	CD	This is the IR camera cryostat inseide which all t...
IC-DE	Infrared Camera Detector Syst...	System	CD	This subsystem is composed by all the detectors...

Figure 17: *PT element View showing all the PT or configuration elements introduced in the tool*

Select a Product Tree element among the ones listed in the table at the right side of the window by double-clicking with the left button of the mouse.

The Product Tree Elements Form will be opened only with the selected record available.

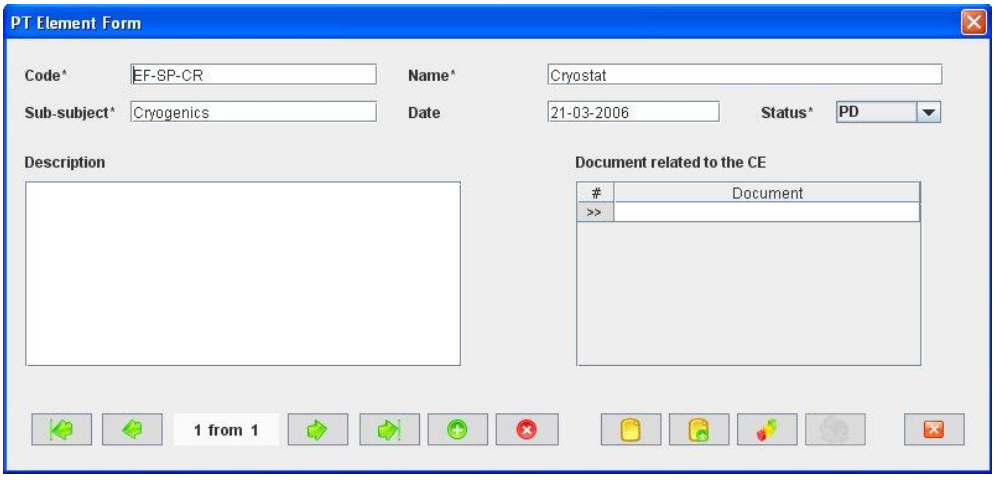


Figure 18: *PT Elements Form (only with the selected record)*

B. Add a new record.

In the PT Elements form, new Product Tree elements can be created in two different ways:

B.I. Starting an empty Product Tree element.

In the PT Elements form (Figure 18), click the *Add button* to add a new record,

A new PT elements Form will be opened empty and ready to be filled.

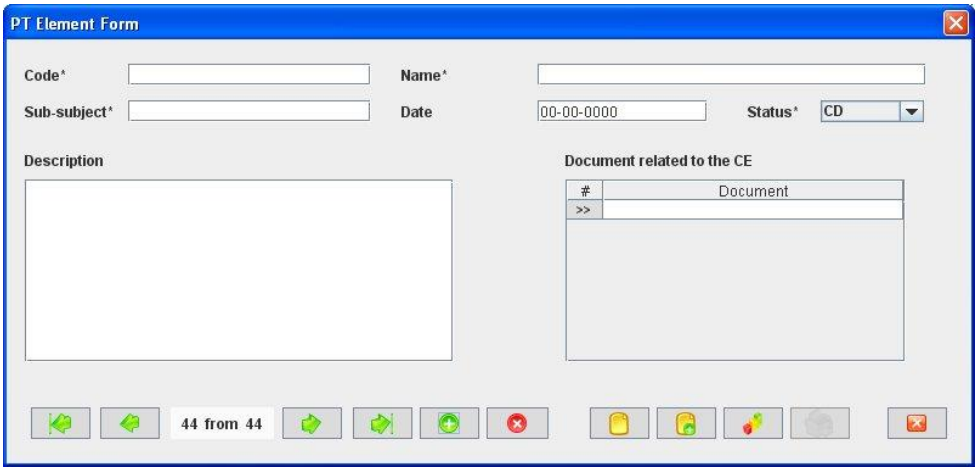


Figure 19 : *PT Elements Form ready to introduce a new PT element without re-using information from other configuration elements already recorded in the database*

B.II. Cloning an already existing Product Tree element.

In the PT Elements Form (Figure 18), click the *Copy button* to clone the Product Tree element that is currently selected in the form,

A new PT Elements Form will be opened with several fields cloned from the previous record and ready to be completed.

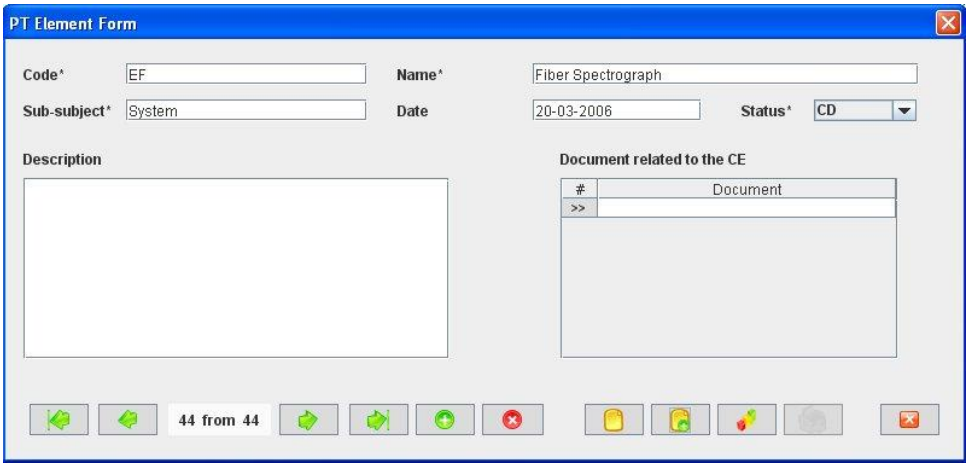


Figure 20: *Configuration Elements Form ready to introduce a new PT element by cloning an existing configuration element (an existing record). In this case we are cloning record #1 (see Figure 16)*

C. Fill in the new record.

In the PT Elements Form, the mandatory fields that must be filled in are the following ones:

- **Code.** Indicate the Product Tree element Code. The Code must be unique for each Product Tree element, because it is going to be used as the base to automatically generate other codes in the application, such as Requirements and Documents. If a code is defined equal to another already assigned to the database, the tool gives a warning and the record cannot be saved. This is a text field with a maximum length of 50 characters.

  The code pattern is as follows:

  AA-AA-AA-AA

  where:

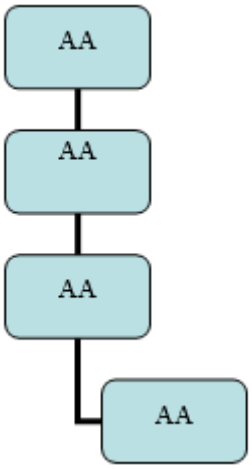
  AA: Product Tree Element acronym to be defined as any combination of alphanumeric characters (excluding the "%"). The length of this acronym is not fixed.

  The PT element code convention is defined before starting to use GECO. More information about it can be found in section 18.

  It is very important to define correctly the PT Elements Codes because the Product Tree structure (i.e., the dependency among the different levels of the PT elements) is established according to the Codes. GECO takes into account where the separator (in this case, "-") is, to decide in which PT level each element is and, also, from which PT high level element this element is hanging.

  AA-AA-AA-AA

  1st level - 2nd level - 3rd level - 4th level



- **Name.** Describe the element in a short and concise way as possible. This is a text field with a maximum length of 200 characters.
- **Sub-subject.** Indicate which subsystem (or group inside the organization) is responsible for this Product Tree element. This is a text field with a maximum length of 20 characters.

- **Status combo box.** Select the status of the Product Tree element among the options offered in the Status combo box, which includes the following ones:
  - CD (Conceptual Design)
  - PD (Preliminary Design)
  - DD (Detailed Design)
  - PRD (PRoDuction Phase)

  By default, the reference line is "CD".

If any of the mandatory fields are not filled, then the tool gives an alert and the record cannot be saved until all the mandatory fields have been introduced.

The rest of the fields that can be optionally filled are:

- **Date.** Indicate the creation date of the Product Tree element. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.
- **Description.** Describe the Product Tree element providing all the information that can be useful. This is a text field and it does not have a maximum length limit.
- **Document codes related to the Configuration Element combo box.** Select the code of the documents that are related to the Product Tree Element. In the combo box, all documents existing in the application can be selected and the user can select as many documents as required.

D. Save the new record.

In the Product Tree elements Form, click the *Save button* to save the record,

If the current record is not saved, the new record will not be created.

E. Close the Product Tree elements Form

In the Product Tree elements Form, click the *Exit button* to exit the form,

If the record has been saved, the Configuration Elements Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 21: *Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving

⇒ Click *NO* to come back to the Product Tree Form.

5.3 Selecting a particular Product Tree Element

In the Main window, the form view of a particular Product Tree element can be opened in two different ways:

A. Going through the Forms Menu.

In the Main window, select *Forms Menu* ⇒ *PT elements Form* or press *ALT+O+E*.

In order to find a particular Product Tree element, the following actions can be done:

⇒ Use the arrows for moving among the Product Tree elements currently selected in the form,

To go to the first record of the selected ones,

To go to the previous record to the current one,

To go to the next record to the current one and

To go to the last record among the selected ones

⇒ Use the *Filter button* to filter/un-filter the set of Product Tree elements currently selected in the form,

A new window will appear:

⇒ Click *Data filter activated box* to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be recorded),

⇒ select in the *Field combo box* the desired field to filter the data,

⇒ select in the *Op combo box* how the previously selected field must match the defined *Value* (i.e., "*starting with*", "*contains*", *"is",* and "*ending by*")

⇒ write in the *Value* text field the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

⇒ define as many filters as required (by adding new lines),

⇒ click *Accept*,

Figure 22: *Filter Window for the Configuration Element View to filter PT elements by fields*

B. Selecting the Product Tree elements in the Product Tree elements View.

In the Main window, click the *Views Menu* ⇒ *PT elements View* or press *ALT+V+E*.

In order to constrain (by Product Tree Element or by filtering) the number of Product Tree elements listed in the view, see the steps to be followed in section 4.2.

Select the desired Product Tree element among the Product Tree elements listed in the table at the right side of the window by double-clicking with the left button of the mouse.

5.4 Modifying existing Product Tree Elements

The Product Tree element to be modified must be already selected, which will be done by following the steps described in section 5.3.

In the Product Tree elements Form, the following steps must be completed in order to modify the selected Product Tree element.

A. Modify the desired fields.

Make the desired changes in the Product Tree element fields, taking into account all constrains identified in section 5.2, numbered item C).

All the fields in the Product Tree elements Form can be modified.

B. Save the modified record.

In the Product Tree elements Form, click the *Save button* to save the record,

If the record is not saved, the changes will not be applied.

C. Close the Product Tree elements form

In the Product Tree elements Form, click the *Exit button* to exit the form,

If the record has been saved, the Product Tree elements Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 23: *Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving

⇒ Click *NO* to come back to the Product Tree Form.

5.5 Deleting a Product Tree Element

The Product Tree element to be deleted must be already selected, which will be done by following the steps described in section 5.3.

In the Product Tree elements Form, the following steps must be done in order to delete the selected Product Tree element.

A. Delete the record.

In the Product Tree elements Form, click the *Delete button* to delete the record,

A new window will appear to ask the user if he/she really wants to delete the record.

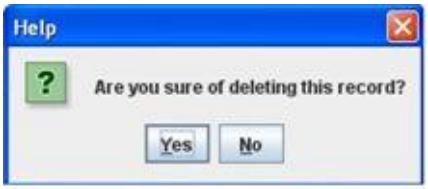


Figure 24: *Warning Window to check if the user wants to delete a record*

⇒ Click *YES* to delete the record.

⇒ Click *NO* to exit without deleting.

5.6 Export PT elements to XLS

In the Main window, click the *Tools Menu ⇒ Export PT elements to XLS*.

A new window will appear where the user must, first, introduce the subsystem and the file name and path to save the xls file, then, click *Accept*.

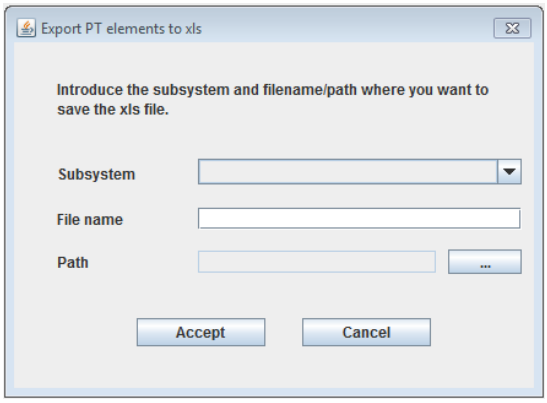


Figure 25: *Window to insert the subsystem and filename/path to generate the xls file*

A new window (it is necessary to have any xls viewer installed) will show a list of the PT elements of the subsystem and lower level elements that has been just introduced.

	A	B	C
1	Code	Name	Description
2	EF	Fiber Spectrograph	This instrument is composed by an optical fibers robot (which is rotat
3	EF-AD	Atmospheric Dispersion Corrector	Optical system that allows to compensate the atmospheric dispersio
4	EF-CF	Field Curvature Corrector	Optical system that corrects the telescope focal plane curvature and
5	EF-CM	Calibration Module	System with different types of lamps (arc lamps, halogen, etc.) that a
6	EF-CS	Control System	Instrument Control System including hardware and software. The soft
7	EF-CU	High level User Software Control System	This subsystem includes the high level user-oriented software packag
8	EF-EC	Electronic Cabinets	Cabinets containing the mechanisms drives controllers, the pressure
9	EF-FS	Optical fibers	Optical fibers, micro-lenses and associated support opto-mechanics.
10	EF-RA	Telescope Rotator Adapter	This is the mechanical interface between the robot and the Telescope
11	EF-RB	Focal Plane Robot	Robot that can position several mechanical articulated arms indepenc
12	EF-SP	Spectrograph	The instrument produces the spectra of the light drove through the fib
13	EF-SP-CA	Camera	Camera of the spectrograph to focus the light coming from the collima
14	EF-SP-CB	Cabling	Cabling
15	EF-SP-CO	Collimator	Collimatorthat produces a collimated beam where the different pupil e
16	EF-SP-CR	Cryostat	
17	EF-SP-CR-100	CCD Head	CCD Head
18	EF-SP-CR-110	CCD Head external body	CCD head external body
19	EF-SP-CR-120	Detector Mount	Detector Mount
20	EF-SP-CR-130	CCD Head temperature components	CCD head temperature components
21	EF-SP-CR-140	Electrical connections	Electrical connections
22	EF-SP-CR-150	Cryostat window	Cryostat window
23	EF-SP-CR-200	Cryostat Rear vessel	
24	EF-SP-CR-210	Cryostat Rear Vessel envelope	Cryostat Rear vessel envelope
25	EF-SP-CR-220	Cryostat Vessel Temperature components	Cryostat Vessel Temperature components
26	EF-SP-CR-230	Rear Vessel Electrical connections	Rear Vessel electrical connections
27	EF-SP-CR-240	Cryostat Pressure Components	Cryostat Pressure Components
28	EF-SP-CR-250	LN2 exhaustion componets	LN2 exhaustion components
29	EF-SP-CR-300	Detector Electronics	Detector Electronics
30	EF-SP-CR-310	Marconi CCD44-82 (detector)	Marconi CCD44-82 (detector)
31	EF-SP-CR-320	Cryostat Internal Panel	Cryostat Internal Panel
32	EF-SP-FE	Fibers Entrance Unit	Fibers Entrance Unit
33	EF-SP-FL	Field Lens	Field Lens

Items

Figure 26: *After entering the subsystem, this window will show the result of the search of all the PT elements of this subsystem and lower level elements found in the database.*

6. PARTS

6.1 What is a Part?

A Part is the lowest level that can be reached in a system breakdown.

In order to maintain a complete inventory of the system, it is important to correctly identify all the system's parts.

The information about parts will be also needed to define in detail the maintenance activities of the whole system.

6.2 Creating a new Part

Starting at the Main Window of the application,

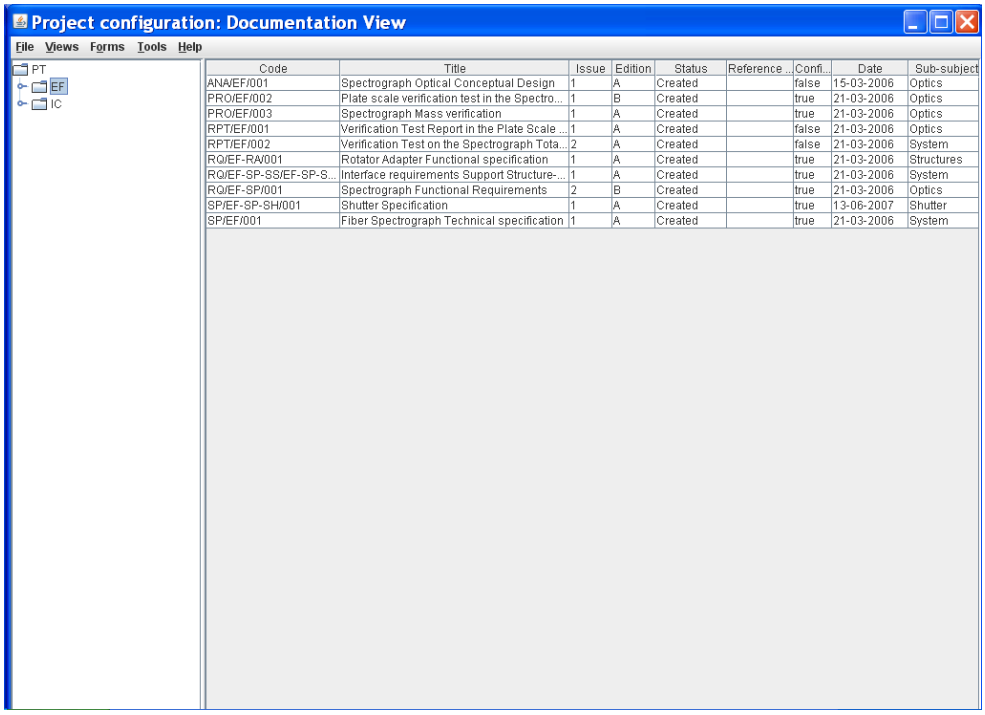


Figure 27: *Main window of the application*

The following steps must be executed in order to create a new Part:

A. Open the Parts form.

In the Main window, the Parts form can be opened in two different ways:

A.I. Going through the Forms Menu.

In the Main window, select *Forms Menu* $\Rightarrow$ *Parts Form* or press *ALT+O+P*.

The Parts Form will be opened with all available records selected.

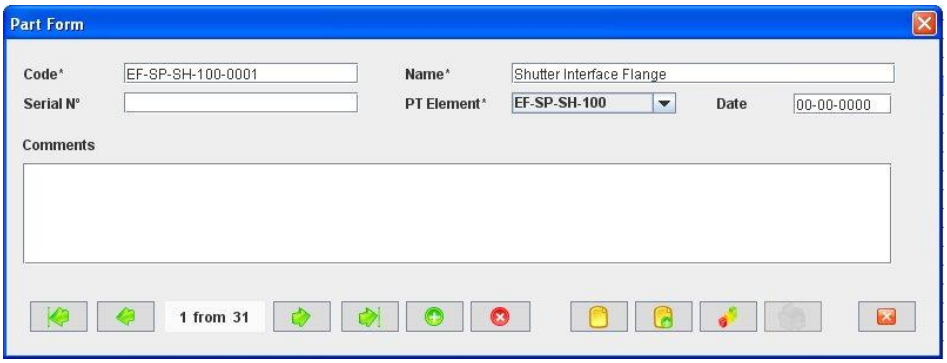


Figure 28: *Parts Form with all the selected records*

A.II. Selecting a Part in the Parts View

In the Main window, click the *Views Menu* ⇒ *Parts View* or press *ALT+V+P*.

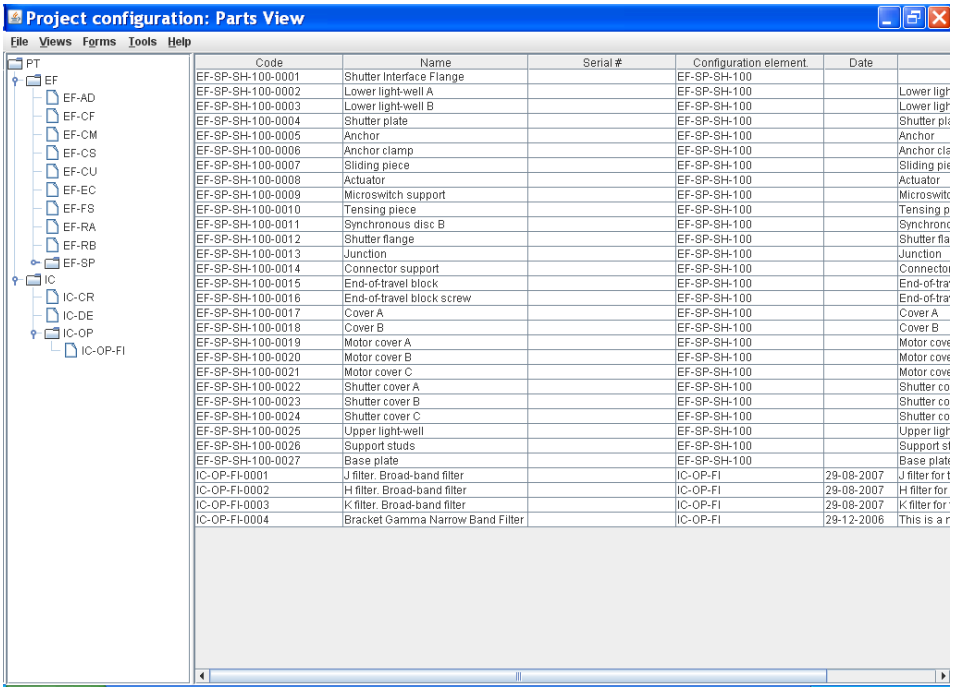


Figure 29: *Parts Views. All the parts of the selected PT elements are shown*

Select a Part among the Parts listed in the table at the right side of the window by double-clicking with the left button of the mouse.

The Parts Form will be opened only with the selected record available.

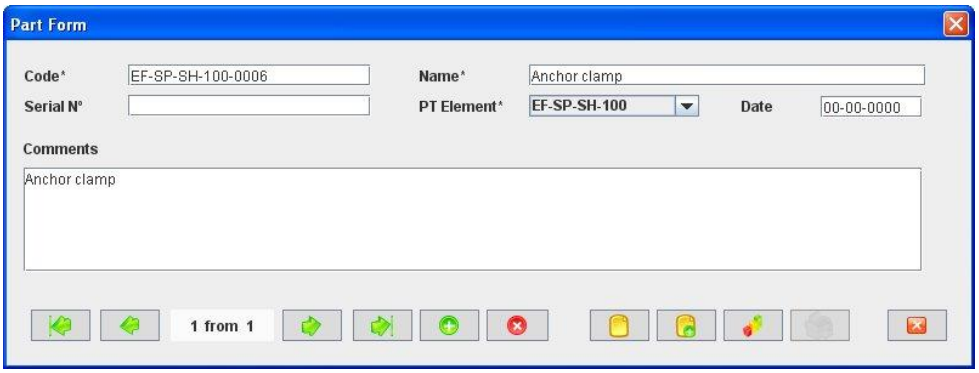


Figure 30: *Parts Form (only with the selected record)*

B. Add a new record.

In the Parts Form, new Parts can be created in two different ways:

B.I. Starting an empty Part.

In the Parts Form, click the *Add button* to add a new record,

A new Part element form will be opened empty and ready to be filled.

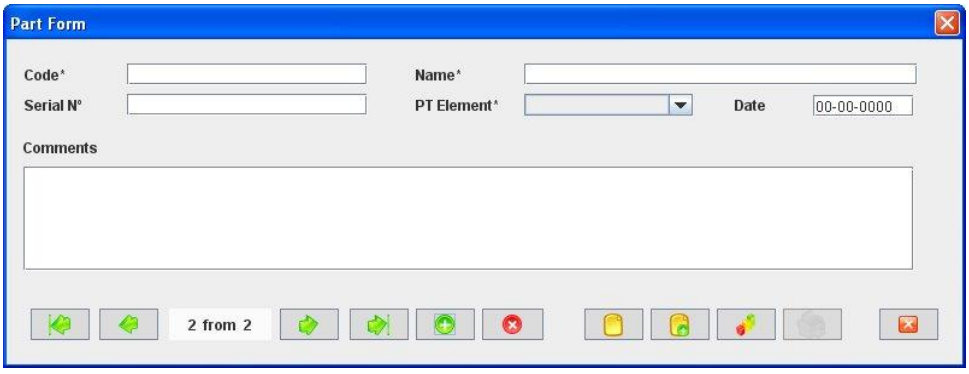


Figure 31: *Parts Form ready to introduce a new part without re-using information from other part already recorded in the database*

B.II. Cloning an already existing Part.

In the Parts Form, click the *Copy button* to clone the Part that is currently selected in the form,

A new Parts Form will be opened with several fields cloned from the previous record and ready to be completed.

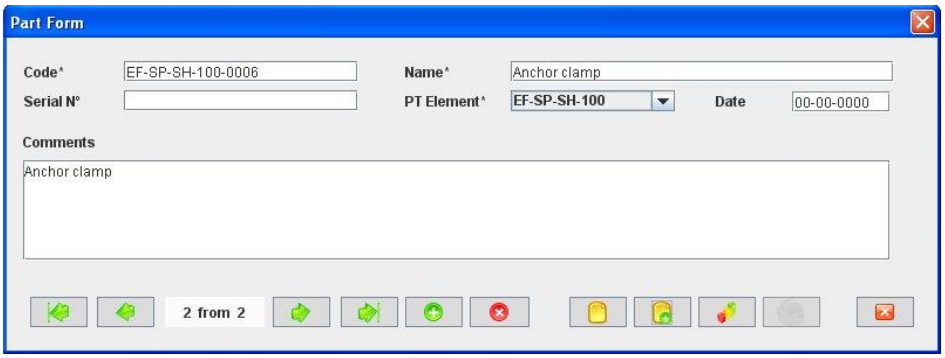


Figure 32: *Parts Form ready to introduce a new part by cloning an existing record*

C. Fill in the new record.

In the Part Form, the mandatory fields that must be filled in are the following ones:

- **Code.** Indicate the Part Code. The Code must be unique for each Part. This is a text field with a maximum length of 80 characters. If a code already in use is entered in the field, at the time of exit the form, the tool will send a warning message (saying that the code already exists in the database and it is not allowed to save the record).
- **Name.** Describe the Part in a short and concise way as possible. This is a text field with a maximum length of 100 characters.
- **PT element combo box.** Select which PT element is on top of the Part. In the combo box, all Product Tree elements existing in the application can be selected.

If any of the mandatory fields are not filled, then the tool gives an alert and the record cannot be saved until all the mandatory fields have been introduced.

The rest of the fields that can be optionally filled are:

- **Serial#.** Indicate the production serial number of the Part. This is a text field with a maximum length of 50 characters.
- **Date.** Indicate the creation date of the Part. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.
- **Comments.** Describe any additional information that can be useful. This is a text field with a maximum length of 400 characters.

D. Save the new record.

In the Parts Form, click the *Save button* to save the record,

If the current record is not saved, the new record will not be created.

E. Close the Parts Form

In the Parts Form, click the *Exit button* to exit the form,

If the record has been saved, the Parts Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 33: *Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving

⇒ Click *NO* to come back to the Parts Form.

6.3 Selecting a particular Part

In the Main window, the form view of a particular Part can be opened in two different ways:

A. Going through the Forms Menu.

In the Main window, select *Forms Menu* ⇒ *Parts Form* or press *ALT+O+P*.

In order to find a particular Part, the following actions can be done:

⇒ Use the arrows for moving among the Parts currently selected in the form,

To go to the first record of the selected ones,

To go to the previous record to the current one,

To go to the next record to the current one and

To go to the last record of the selected ones

⇒ Use the *Filter button* to filter/un-filter the set of Parts currently selected in the form,

A new window will appear:

⇒ Click *Data filter activated box* to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be record),

⇒ select in the *Field combo box* the desired field to filter the data,

⇒ select in the *Op combo box* how the previously selected field must match the defined *Value* (i.e., "*starting with*", "*contains*", *"is",* "*ending by*")

⇒ write in the *Value* text field the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

⇒ define as many filters as wanted (by adding new lines),

⇒ click *Accept*,

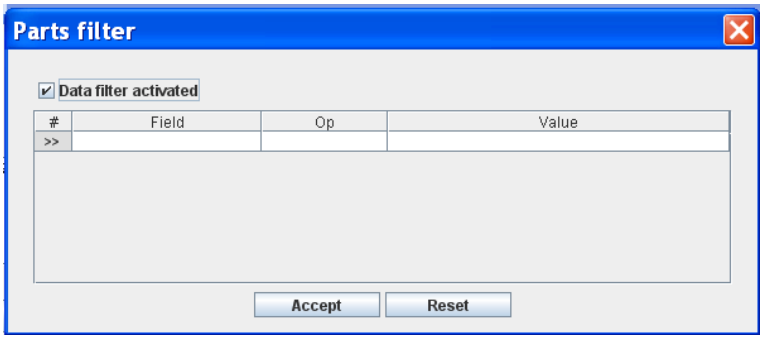


Figure 34: *Form to filter the parts*

B. Selecting the Parts in the Parts View.

In the Main window, click the *Views Menu* ⇒ *Parts View* or press *ALT+V+P*.

In order to constrain (by Product Tree Element or by filtering) the number of Parts listed in the view, see the steps to be followed in section 4.2.

Select the desired Part among the Parts listed in the table at the right side of the window by double-clicking with the left button of the mouse.

6.4 Modifying existing Parts

The Part to be modified must be already selected, which will be done by following the steps described in section 6.3.

In the Parts Form, the following steps must be done in order to modify the selected Part.

A. Modify the desired fields.

Make the desired changes in the Part fields, taking into account all constrains identified in section 6.2, numbered item C).

All the fields in the Parts form can be modified.

B. Save the modified record.

In the Parts Form, click the *Save button* to save the record,

If the record is not saved, the changes will not be applied.

C. Close the Parts form

In the Parts Form, click the *Exit button* to exit the form,

If the record has been saved, the Parts Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 35: *Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving.

⇒ Click *NO* to come back to the Parts Form.

6.5 Deleting a Part

The Part to be deleted must be already selected, which will be done by following the steps described in section 6.3.

In the Parts Form, the following steps must be done in order to delete the selected Part.

A. Delete the record.

In the Parts Form, click the *Delete button* to delete the record,

A new window will appear to ask the user if he/she really wants to delete the record.

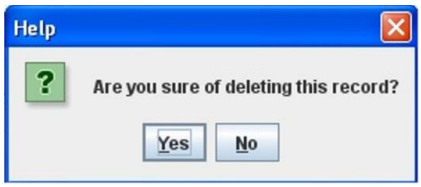


Figure 36: *Warning Window to check if the user wants to delete the record*

⇒ Click *YES* to delete the record.

⇒ Click *NO* to exit without deleting.

6.6 Export Parts to XLS

In the Main window, click the *Tools Menu* ⇒ *Export Parts to XLS*.

A new window will appear where the user must, first, introduce the subsystem and the file name and path to save the xls file, then, click *Accept*.

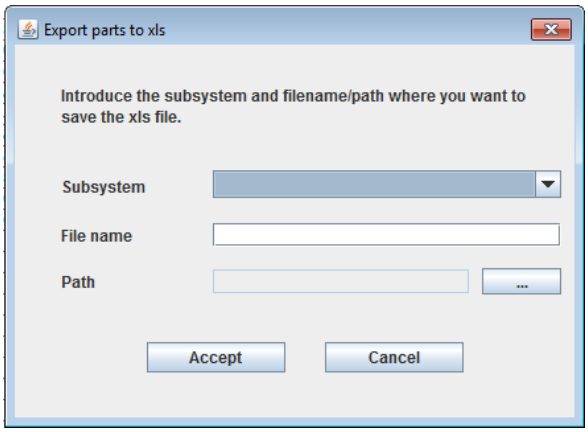


Figure 37: *Window to insert the subsystem and filename/path to generate the xls file*

A new window (it is necessary to have any xls viewer installed) will show a list of the parts of the subsystem and lower level elements that has been just introduced.

	A	B	C	D	E
1	Code	Name	PT Element	Serial number	Comments
2	EF-SP-SH-100-0001	Shutter Interface Flange	EF-SP-SH-100		
3	EF-SP-SH-100-0002	Lower light-well A	EF-SP-SH-100		Lower light-well A
4	EF-SP-SH-100-0003	Lower light-well B	EF-SP-SH-100		Lower light-well B
5	EF-SP-SH-100-0004	Shutter plate	EF-SP-SH-100		Shutter plate
6	EF-SP-SH-100-0005	Anchor	EF-SP-SH-100		Anchor
7	EF-SP-SH-100-0006	Anchor clamp	EF-SP-SH-100		Anchor clamp
8	EF-SP-SH-100-0007	Sliding piece	EF-SP-SH-100		Sliding piece
9	EF-SP-SH-100-0008	Actuator	EF-SP-SH-100		Actuator
10	EF-SP-SH-100-0009	Microswitch support	EF-SP-SH-100		Microswitch support
11	EF-SP-SH-100-0010	Tensing piece	EF-SP-SH-100		Tensing piece
12	EF-SP-SH-100-0011	Synchronous disc B	EF-SP-SH-100		Synchronous disc B
13	EF-SP-SH-100-0012	Shutter flange	EF-SP-SH-100		Shutter flange
14	EF-SP-SH-100-0013	Junction	EF-SP-SH-100		Junction
15	EF-SP-SH-100-0014	Connector support	EF-SP-SH-100		Connector support
16	EF-SP-SH-100-0015	End-of-travel block	EF-SP-SH-100		End-of-travel block
17	EF-SP-SH-100-0016	End-of-travel block screw	EF-SP-SH-100		End-of-travel block screw
18	EF-SP-SH-100-0017	Cover A	EF-SP-SH-100		Cover A
19	EF-SP-SH-100-0018	Cover B	EF-SP-SH-100		Cover B
20	EF-SP-SH-100-0019	Motor cover A	EF-SP-SH-100		Motor cover A
21	EF-SP-SH-100-0020	Motor cover B	EF-SP-SH-100		Motor cover B
22	EF-SP-SH-100-0021	Motor cover C	EF-SP-SH-100		Motor cover C
23	EF-SP-SH-100-0022	Shutter cover A	EF-SP-SH-100		Shutter cover A
24	EF-SP-SH-100-0023	Shutter cover B	EF-SP-SH-100		Shutter cover B
25	EF-SP-SH-100-0024	Shutter cover C	EF-SP-SH-100		Shutter cover C
26	EF-SP-SH-100-0025	Upper light-well	EF-SP-SH-100		Upper light-well
27	EF-SP-SH-100-0026	Support studs	EF-SP-SH-100		Support studs
28	EF-SP-SH-100-0027	Base plate	EF-SP-SH-100		Base plate
29					

Items

Figure 38: *After entering the subsystem, this window will show the result of the search of all the parts of this subsystem and lower level elements found in the database.*

7. INTERFACES

7.1 What is an Interface?

An Interface is defined as the border between two subsystems (hardware or software). Interfaces among subsystems that are under the responsibility of different working groups are especially important to be controlled.

The interfaces must be identified and introduced in the application during the system design in order to avoid any problems during the integration of the system.

7.2 Creating a new Interface

Starting at the Main Window of the application,

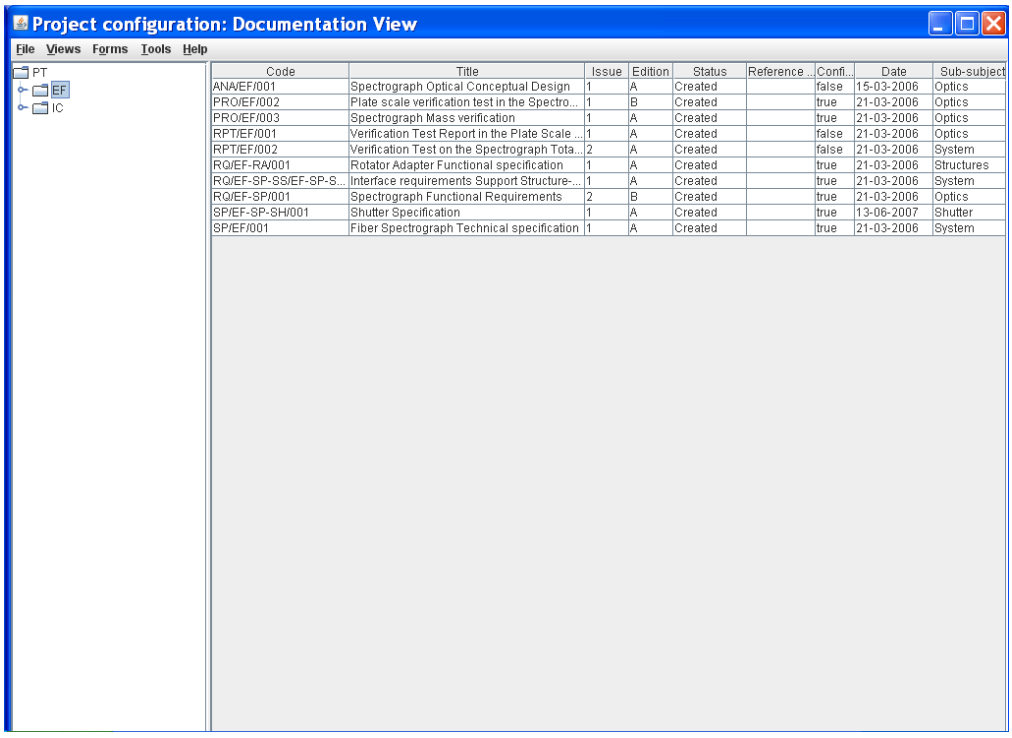


Figure 39: *Main window of the application*

The following steps must be executed in order to create a new Interface:

A. Open the Interface form.

In the Main window, the Interfaces form can be opened in two different ways:

A.I. Going through the Forms Menu.

In the Main window, select *Forms Menu* $\Rightarrow$ *Interfaces Form* or press *ALT+O+I*.

The Interfaces Form will be opened with all available records selected.

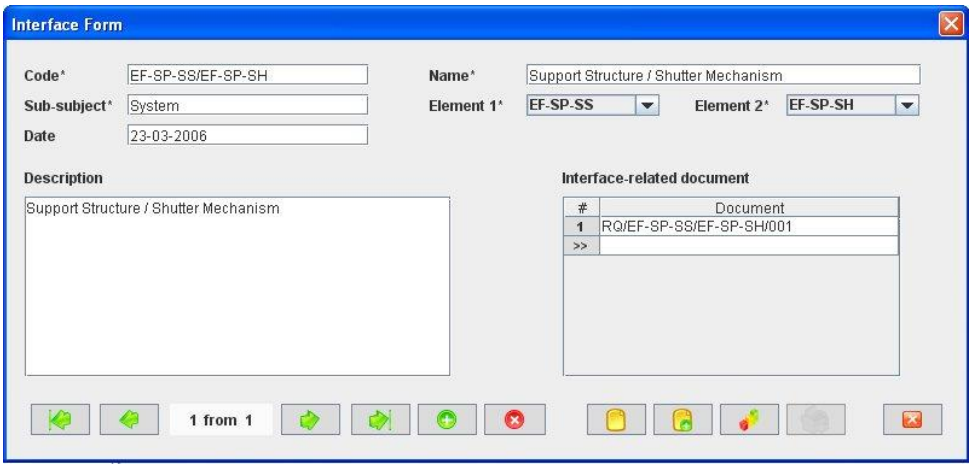


Figure 40: *Interfaces Form with all selected records*

A.II. Selecting an Interface in the Interfaces View.

In the Main window, click the *Views Menu* ⇒ *Interfaces View* or press *ALT+V+I*.

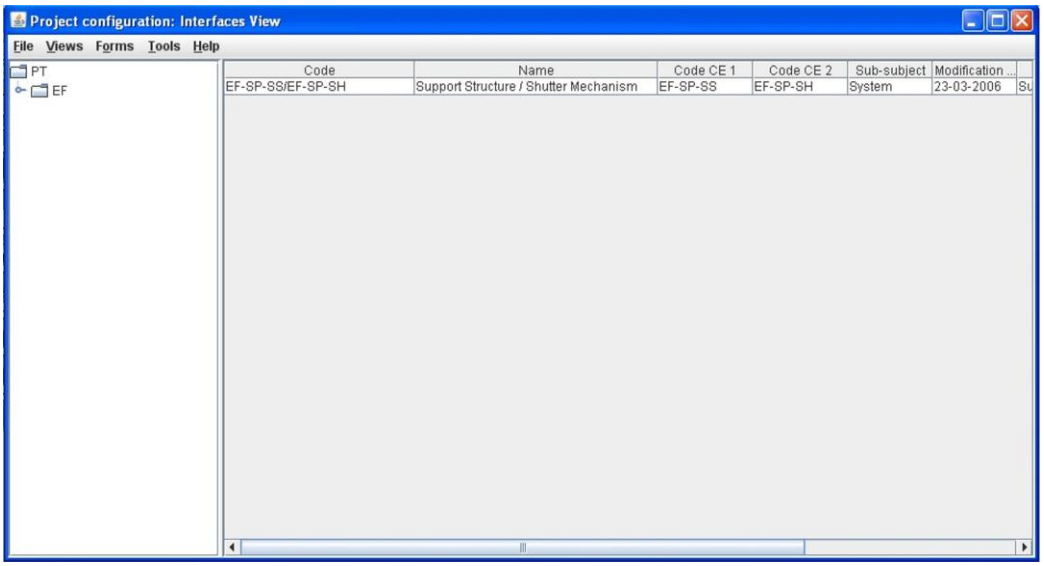


Figure 41: *Interfaces View with all the recorded interfaces shown on the right panel*

Select an Interface among the Interfaces listed in the table at the right side of the window by double-clicking with the left button of the mouse.

The Interfaces Form will be opened only with the selected record available.

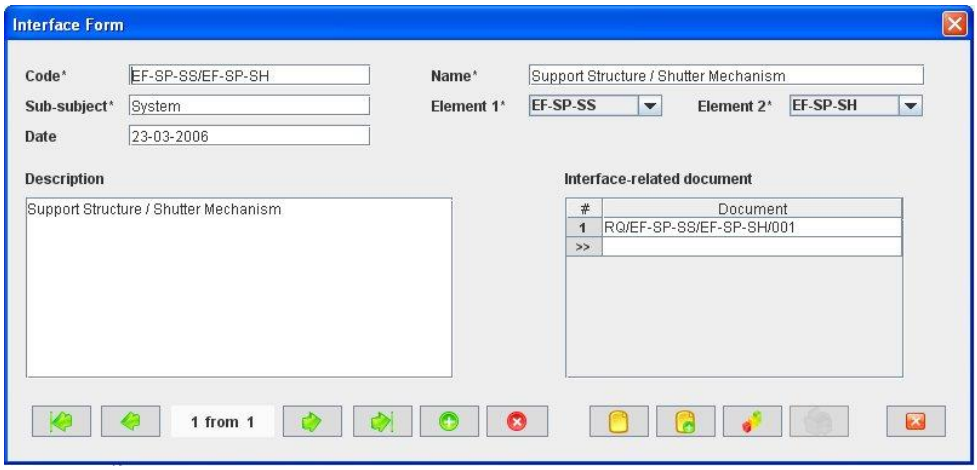


Figure 42: *Interfaces Form showing only the selected record*

B. Add a new record.

In the Interfaces Form, new Interfaces can be created in two different ways:

B.I. Starting an empty Interface.

In the Interface Form, click the *Add button* to add a new record,

A new Interface element form will be opened empty and ready to be filled.

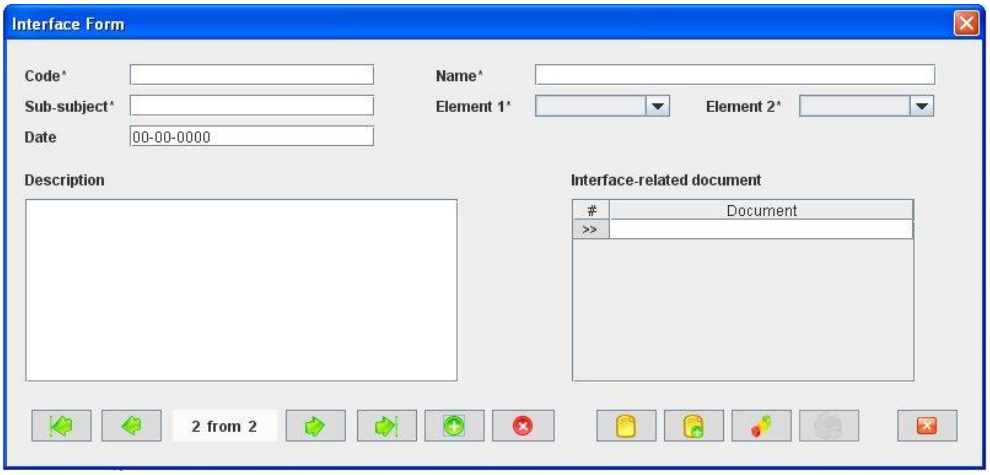


Figure 43: *Interface Form ready to introduce a new interface without re-using information from other part already recorded in the database*

B.II. Cloning an already existing Interface.

In the Interfaces Form, click the *Copy button* to clone the Interface that is currently selected in the form,

A new Interfaces Form will be opened with several fields cloned from the previous record and ready to be completed.

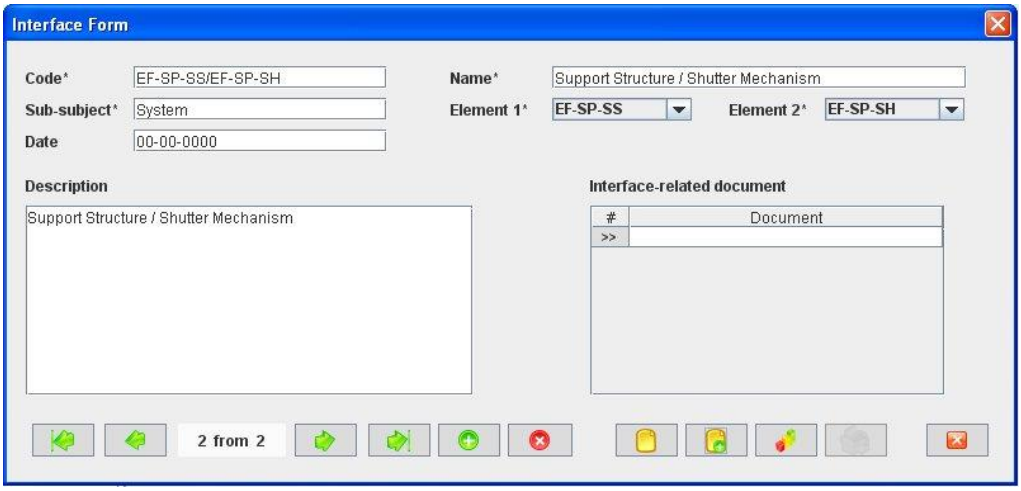


Figure 44: *Interface Form ready to introduce a new part by cloning an existing record*

C. Fill in the new record.

In the Interface Form, the mandatory fields that must be filled in are:

- **Code.** Indicate the Interface Code. The Code must be unique for each Interface, since it is going to be used as a base to automatically generate other codes in the application, such as Requirements and Documents. This is a text field with a maximum length of 110 characters. Be aware that the IF code is not automatically generated to give the user flexibility to use their own codes but it should be connected to the related PT elements codes. Also, it is possible to define several interfaces between the same configuration elements; although this is not a common practice, it could be used by some organizations.

- **Name.** Describe the Interface in the shortest and most concise way possible. This is a text field with a maximum length of 80 characters.

- **Sub-subject.** Indicate which subsystem (or group inside the organization) is responsible for this Interface. This is a text field with a maximum length of 20 characters.

- **Element 1 combo box.** The interface is defined in the border between two PT elements. Select the first one of this two PT element. In the combo box, all Product Tree elements existing in the application can be selected.

- **Element 2 combo box.** The interface is defined in the border between two PT elements. Select the second one of this two PT element. In the combo box, all Product Tree elements existing in the application will be accessible.

If any of the mandatory fields are not filled, then the tool gives an alert and the record cannot be saved until all the mandatory fields have been introduced.

The rest of the fields that can be optionally filled are:

- **Date.** Indicate the creation date of the Interface. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.
- **Description.** Describe any additional information that can be useful. This is a text field and it does not have a maximum length limit.
- **Interface-related documents combo box.** Select the code of the documents that are related to the Interface. In the combo box, all documents existing in the application can be selected and the user can select as many documents as required.

D. Save the new record.

In the Interfaces Form, click the *Save button* to save the record,

If the current record is not saved, the new record will not be created.

E. Close the Interfaces Form

In the Interfaces Form, click the *Exit button* to exit the form,

If the record has been saved, the Interfaces Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 45: *Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving.

⇒ Click *NO* to come back to the Interfaces Form.

7.3 Selecting a particular Interface

In the Main window, the form view of a particular Interface can be opened in two different ways:

A. Going through the Forms Menu.

In the Main window, select *Forms Menu* ⇒ *Interfaces Form* or press *ALT+O+I*.

In order to find a particular Interface, the following actions can be done:

⇒ Use the arrows for moving among the Interfaces currently selected in the form,

To go to the first record of the selected ones,

To go to the previous record to the current one,

To go to the next record to the current one and

To go to the last record of the selected ones

⇒ Use the *Filter button* to filter/un-filter the set of Interfaces currently selected in the form,

A new window will appear:

⇒ Click *Data filter activated box* to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be reset),

⇒ select in the *Field combo box* the desired field to filter the data,

⇒ select in the *Op combo box* how the previously selected field must match the defined *Value* (i.e., "*starting with*", "*contains", "is",* "*ending by*")

⇒ write in the *Value* text field the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

⇒ define as many filters as wanted (by adding new lines),

⇒ click *Accept*,

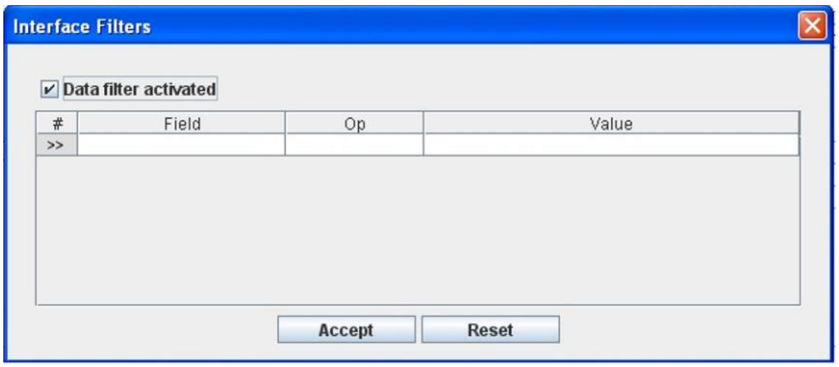


Figure 46: *Interface Filter to select the desired interface records by different fields*

B. Selecting the Interfaces in the Interfaces View.

In the Main window, click the *Views Menu* ⇒ *Interfaces View* or press *ALT+V+I*.

In order to constrain (by Product Tree Element or by filtering) the number of Interfaces listed in the view, see the steps to be followed in section 4.2.

Select the desired Interface among the Interfaces listed in the table at the right side of the window by double-clicking with the left button of the mouse.

7.4 Modifying existing Interfaces

The Interface to be modified must be already selected, which will be done by following the steps described in section 7.3.

In the Interfaces Form, the following steps must be done in order to modify the selected Interface.

A. Modify the desired fields.

Make the desired changes in the Interface fields, taking into account all constrains identified in section 7.2, numbered item C).

All the fields in the Interfaces Form can be modified.

B. Save the modified record.

In the Interfaces Form, click the *Save button* to save the record,

If the record is not saved, the changes will not be applied.

C. Close the Interfaces form

In the Interfaces Form, click the *Exit button* to exit the form,

If the record has been saved, the Interfaces Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 47: *Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving.

⇒ Click *NO* to come back to the Interfaces Form.

7.5 Deleting an Interface

The Interface to be deleted must be already selected, which will be done by following the steps described in section 7.3.

In the Interfaces Form, the following steps must be done in order to delete the selected Interface.

A. Delete the record.

In the Interfaces Form, click the *Delete button* to delete the record,

A new window will appear to ask the user if he/she really wants to delete the record.

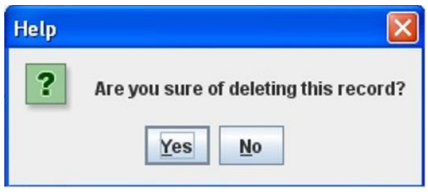


Figure 48: *Warning Window to check if the user wants to delete the record*

⇒ Click *YES* to delete the record.

⇒ Click *NO* to exit without deleting.

7.6 Export Interfaces to XLS

In the Main window, click the *Tools Menu* ⇒ *Export Interfaces to XLS*.

A new window will appear where the user must, first, introduce the subsystem and the file name and path to save the xls file, then, click *Accept*.

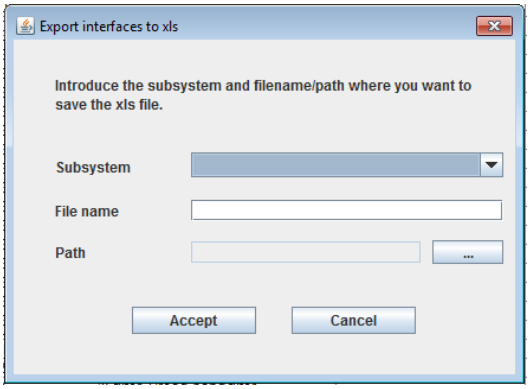


Figure 49: *Window to insert the subsystem and filename/path to generate the xls file*

A new window (it is necessary to have any xls viewer installed) will show a list of the interfaces of the subsystem and lower level elements that has been just introduced.

	A	B	C	D	E
1	Code	Name	PT Element	Serial number	Comments
2	EF-SP-SH-100-0001	Shutter Interface Flange	EF-SP-SH-100		
3	EF-SP-SH-100-0002	Lower light-well A	EF-SP-SH-100		Lower light-well A
4	EF-SP-SH-100-0003	Lower light-well B	EF-SP-SH-100		Lower light-well B
5	EF-SP-SH-100-0004	Shutter plate	EF-SP-SH-100		Shutter plate
6	EF-SP-SH-100-0005	Anchor	EF-SP-SH-100		Anchor
7	EF-SP-SH-100-0006	Anchor clamp	EF-SP-SH-100		Anchor clamp
8	EF-SP-SH-100-0007	Sliding piece	EF-SP-SH-100		Sliding piece
9	EF-SP-SH-100-0008	Actuator	EF-SP-SH-100		Actuator
10	EF-SP-SH-100-0009	Microswitch support	EF-SP-SH-100		Microswitch support
11	EF-SP-SH-100-0010	Tensing piece	EF-SP-SH-100		Tensing piece
12	EF-SP-SH-100-0011	Synchronous disc B	EF-SP-SH-100		Synchronous disc B
13	EF-SP-SH-100-0012	Shutter flange	EF-SP-SH-100		Shutter flange
14	EF-SP-SH-100-0013	Junction	EF-SP-SH-100		Junction
15	EF-SP-SH-100-0014	Connector support	EF-SP-SH-100		Connector support
16	EF-SP-SH-100-0015	End-of-travel block	EF-SP-SH-100		End-of-travel block
17	EF-SP-SH-100-0016	End-of-travel block screw	EF-SP-SH-100		End-of-travel block screw
18	EF-SP-SH-100-0017	Cover A	EF-SP-SH-100		Cover A
19	EF-SP-SH-100-0018	Cover B	EF-SP-SH-100		Cover B
20	EF-SP-SH-100-0019	Motor cover A	EF-SP-SH-100		Motor cover A
21	EF-SP-SH-100-0020	Motor cover B	EF-SP-SH-100		Motor cover B
22	EF-SP-SH-100-0021	Motor cover C	EF-SP-SH-100		Motor cover C
23	EF-SP-SH-100-0022	Shutter cover A	EF-SP-SH-100		Shutter cover A
24	EF-SP-SH-100-0023	Shutter cover B	EF-SP-SH-100		Shutter cover B
25	EF-SP-SH-100-0024	Shutter cover C	EF-SP-SH-100		Shutter cover C
26	EF-SP-SH-100-0025	Upper light-well	EF-SP-SH-100		Upper light-well
27	EF-SP-SH-100-0026	Support studs	EF-SP-SH-100		Support studs
28	EF-SP-SH-100-0027	Base plate	EF-SP-SH-100		Base plate
29					

Items

Figure 50: *After entering the subsystem, this window will show the result of the search of all the interfaces of this subsystem and lower level elements found in the database.*

8. REQUIREMENTS

8.1 What is a Requirement?

A requirement is defined as the capacity or condition that a system, subsystem or component must fulfil to satisfy the specification or contract that has been formally imposed to this system, subsystem or component.

GECO is thought to manage all the requirements that must be produced during the design of a system, which comprise the Functional Requirements and the Technical Requirements.

- At the beginning of a design, the Functional Requirements are defined to describe the needs of the system, subsystem or component that is going to be designed.
- After a solution is found for the system, subsystem or component, the Technical Requirements are defined to describe this solution.

Elsewhere, Functional and Technical Requirements are named as Requirements and Specifications.

The requirements for a system, subsystem or component are normally grouped in a Requirement or Specification document. The user must define the requirements paying attention that the set of requirements is coherent, consistent and without conflicts among them.

Thinking in how to organize the requirements inside the documents, GECO has been implemented to allow the user organizing the requirements in two levels: sections and subsections. More information about the generation of requirement document can be found in section 10.6.

8.2 Creating a new Requirement

Starting at the Main Window of the application,

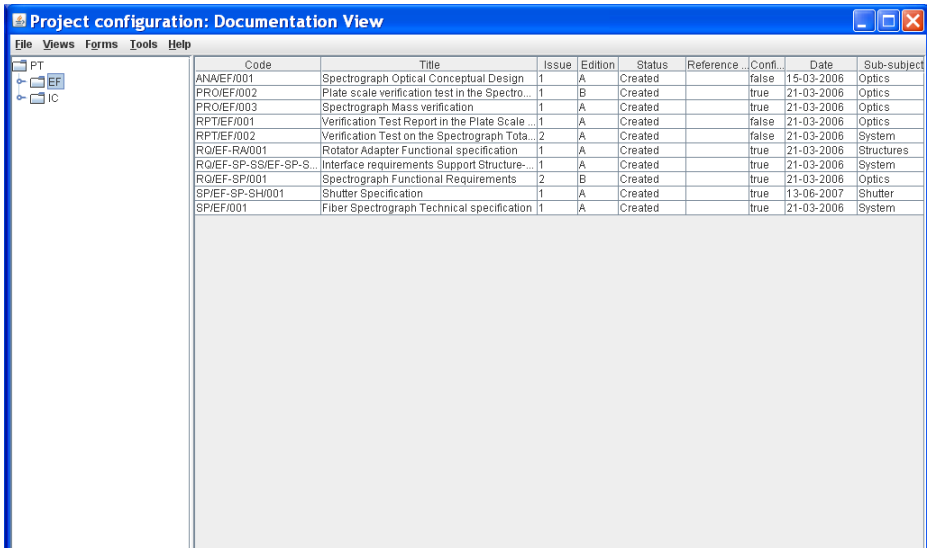


Figure 51: *Main window of the application*

The following steps must be executed in order to create a new Requirement:

A. Open the Requirements Form.

In the Main window, the Requirements Form can be opened in two different ways:

A.I. Going through the Forms Menu.

In the Main window, select *Forms Menu* ⇒ *Requirements Form* or press *ALT+O+R*.

The Requirements Form will be opened with all available records selected.

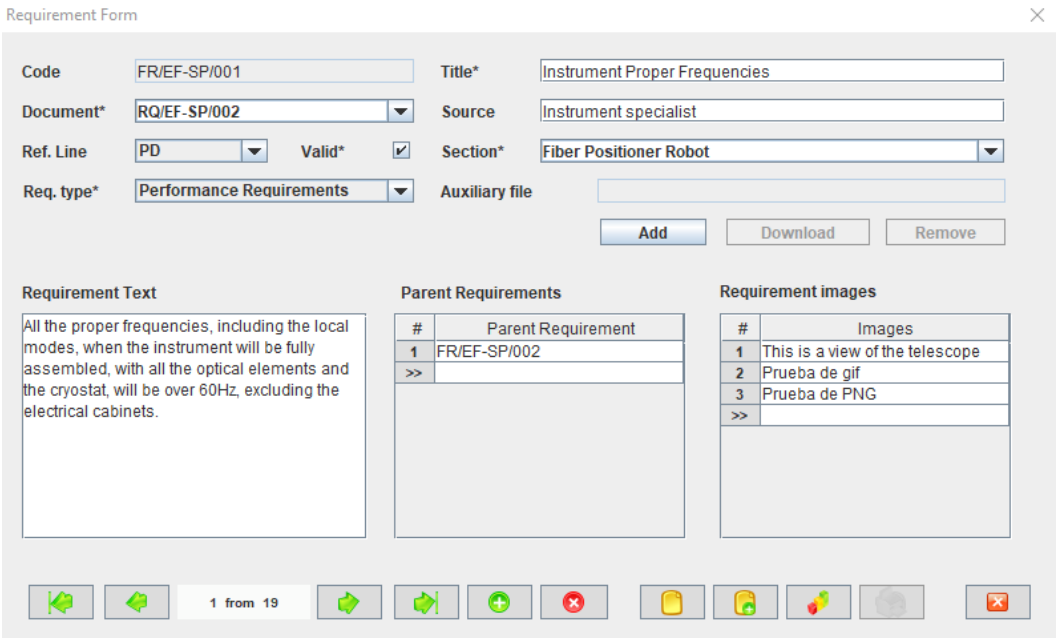


Figure 52: *Requirements Form showing all the selected records*

A.II. Selecting a Requirement in the Requirements View.

In the Main window, click the *Views Menu* ⇒ *Requirements View* or press *ALT+V+R*.

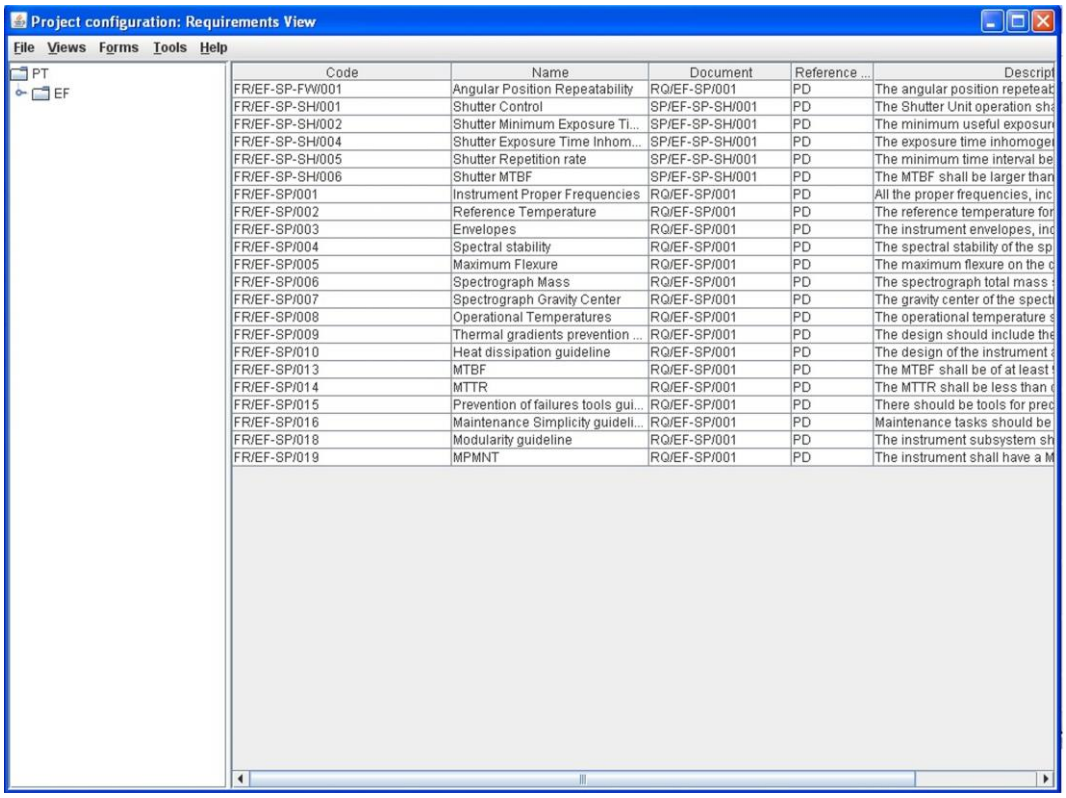


Figure 53: *Requirements View (right panel) showing all the selected requirements associated to the selected PT element (left panel)*

Select a Requirement among the Requirements listed in the table at the right side of the window by double-clicking with the left button of the mouse.

The Requirements Form will be opened only with the selected record available.

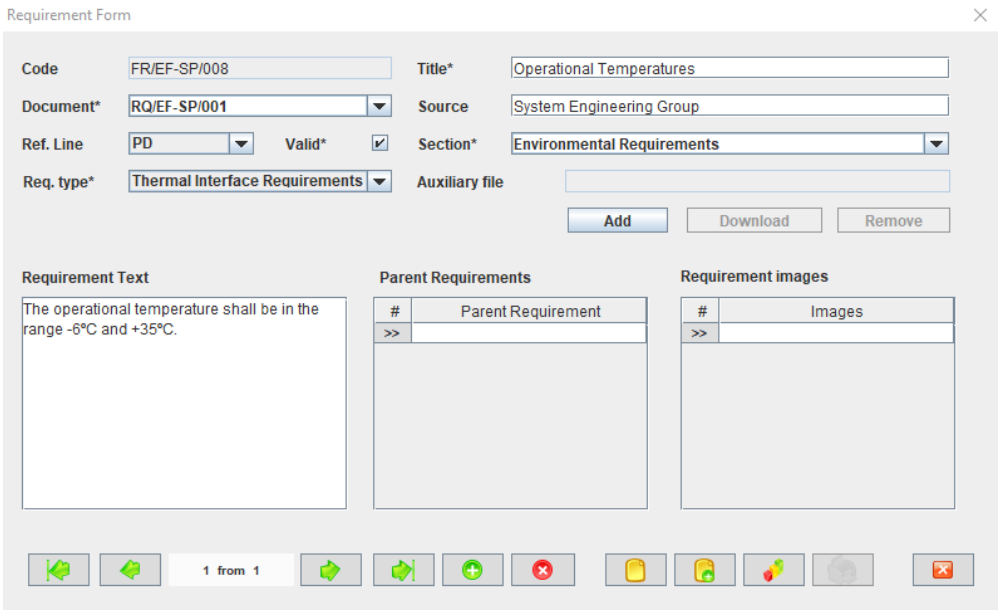


Figure 54: *Requirements Form showing only the selected record*

B. Add a new record.

In the Requirements form, new requirement can be created in two different ways:

B.I. Starting an empty requirement.

In the Requirements Form, click the *Add button* to add a new record,

A new window will appear,

⇒ select the requirement type in the *Requirement Type combo box*,

⇒ select the Product Tree or Interface code in the *PT Element or interface combo box*,

⇒ click *Accept*,

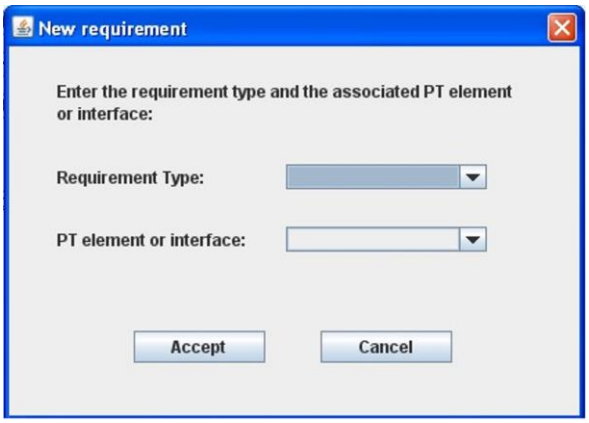


Figure 55: *Requirements Form*

The new Requirement **Code** will be automatically generated as the first one available for the Requirement type and Product Tree or Interface code selected.

All requirement Codes follow the same pattern as described below:

TT/PT/nnn

where,

TT: FR (Functional Requirement) or TR (Technical Requirement)

PT: Product Tree Element or Interface code

nnn: Sequence number that will be automatically generated by the application

The Requirement Code is unique for each requirement.

The user can change of this **Code** the Product Tree or Interface and/or the number.

The Requirement code convention is defined before starting to use GECO. More information about it can be found in section 18.

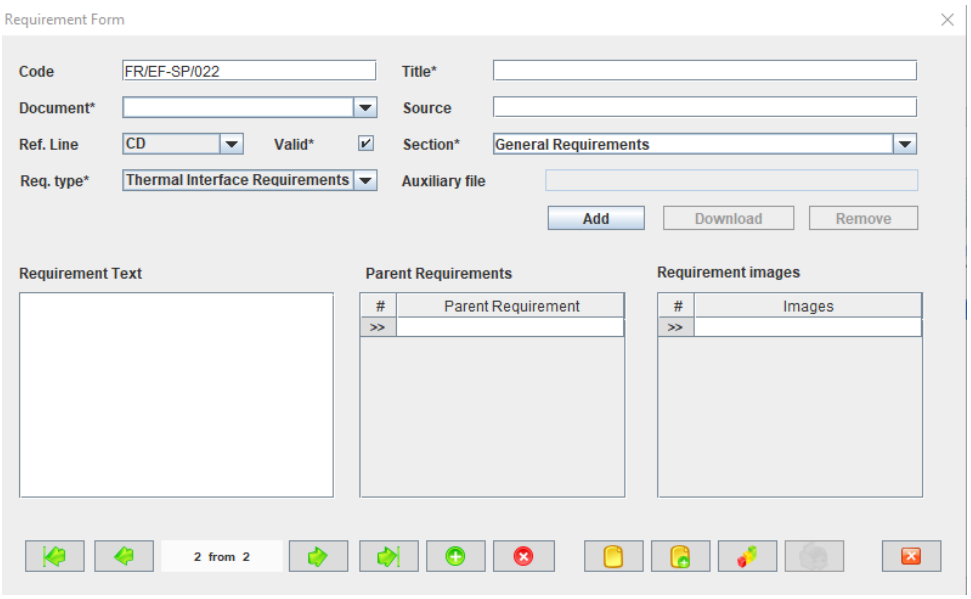


Figure 56: *Requirements Form once the PT element or interface and the requirement type has been chosen as shown in Figure 55.*

B.II. Cloning an already existing Requirement.

In the Requirements Form, click the *Copy button* to clone the requirement that is currently selected in the form,

The new Requirement **Code** will be automatically generated as the first one available for the same Requirement type and Product Tree or Interface code of the Requirement that has been cloned.

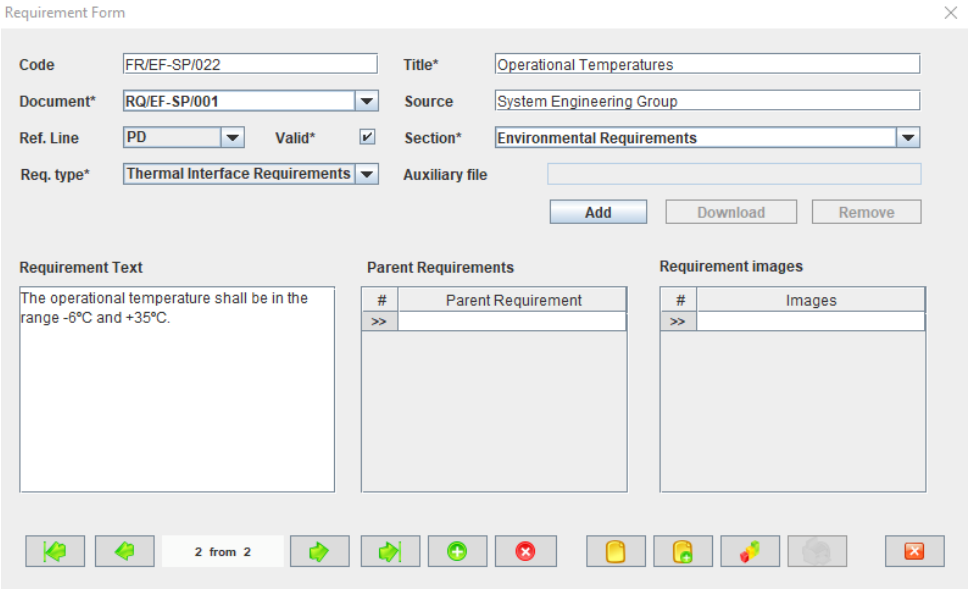


Figure 57: *Requirements Form ready to introduce a new requirement by cloning an existing record*

C. Fill in the new record.

In the Requirements Form, the mandatory fields that must be filled in are the following ones:

- **Code.** The requirement code is automatically generated by the application, but it can be modified by the user. If so, the application will check that there is no other requirement with the same code before saving the record. This is a text field with a maximum length of 60 characters.
- **Title.** Describe the objective of the requirement in the shortest and more concise way possible. This is a text field with a maximum length of 150 characters.
- **Valid.** Indicate if the requirement is still applicable or not. This means that the requirement can be migrated to the corresponding document or not. By default, all requirements are applicable.
- **Reference line combo box.** Select the reference line of the requirement among the options offered in the Reference line combo box, which are the following ones:
    - CD (Conceptual Design)
    - PD (Preliminary Design)
    - DD (Detailed Design)
    - PRD (PRoDuction Phase)

  By default, the reference line is "CD".
- **Document combo box.** Select the code of the Requirement or Specification document that is going to include this requirement. In the combo box, all Requirement (REQ/…) and Specification (SPE/…) documents existing in the application will be accessible.
- **Type combo box.** Select the requirement type among the options offered in the Type combo box, which includes the following ones:
    - Functional Requirement
    - Performance Requirement
    - Physical Requirement
    - Environmental Requirement
    - Operation Requirement
    - Personnel Requirement
    - Production Requirement
    - Handling Requirement
    - RAMS Requirement
    - Configuration Requirement

- Standardization Requirement
- Design Requirement
- Functional Interface Requirement
- Thermal Interface Requirement
- Electrical Interface Requirement
- Physical Interface Requirement
- Software Interface Requirement

The requirement type will be used later to define the subsection of the requirement whenever it is exported to a document (see section 10.6). By default, the requirement type is *"Functional requirement"*.

- **Section combo box.** Select or introduce the requirement section. That is, the user can select any of the options already included into the combo box (that offers all the sections previously defined for the document of the requirement) or, alternatively, introduce manually a new section; in this case, the section will be added to the combo box list for the next time this option is used. By default, the section is *"General requirements"*. When a new section is introduced, it must be taken into account that the maximum length of this field is 80 characters.

If any of the mandatory fields are not filled, then the tool gives an alert and the record cannot be saved until all the mandatory fields have been introduced.

The rest of the fields that can be optionally filled are:

- **Source.** Indicate the origin of the requirement, i.e., which person, organism or document is responsible for this requirement. It is important to mention that all requirements should be justified either by a **Source** or by one or several **Parent Requirements,** or by both. This is a text field and it does not have a maximum length limit.
- **Auxiliary file.** Introduce an auxiliary file, if desired, for this requirement. Select the auxiliary file from the File Manager when clicking in the *Add Button.*
- **Parent Requirements combo box.** Select as many Parent Requirements as necessary to indicate what already defined requirements are the origins of the current Requirement. It is important to mention that all requirements should be justified either by a **Source** or by one or several **Parent Requirements**. In the combo box, all requirements already existing in the application will be accessible.
- **Description.** Describe the content of the Requirement. It is convenient to follow the System Engineering practice rules as summarized in the following lines:
  - A requirement must be unique and not a combination of several requirements.
  - A requirement must not reference others requirements inside its text.
  - A requirement must be brief and easy to read and to understand. Explanations about the requirement could be in an analysis document which can be referenced in the **Source** of the requirement.

- A requirement must not be ambiguous. So, wording like “and/or”, “etc”, “maximize”, “minimize”, “as much as possible”, etc., must be avoided.
- Technical requirements must be reachable and verifiable.

This is a text field and it does not have a maximum length limit.

- **Images combo box.** Introduce as many images as needed to complete the content of the Requirement (i.e., all information that does not suit in a text paragraph, such as equations, tables, figures, etc., must be converted into image format to be included in the requirement). When a new combo box row is selected, a new window will appear,

  ⇒ introduce the *Title* of the image,

  ⇒ select the image *Path*, by writing it directly in the text line or opening the File Manager when clicking in the *File Explorer Button*,

  ⇒ select if the image is going to be stored in the Database or only the reference to it by clicking in the *File by reference* box,

  ⇒ click *Accept*,

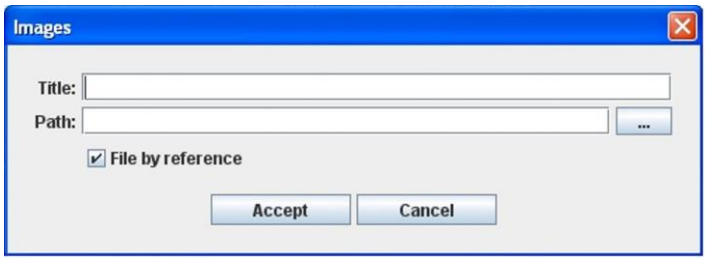


Figure 58: *Window to include an image associated to a requirement*

D. Save the new record.

In the Requirements Form, click the *Save button* to save the record,

If the current record is not saved, the new record will not be created.

E. Close the Requirements Form

In the Requirements Form, click the *Exit button* to exit the form,

If the record has been saved, the Requirements Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 59: *Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving

⇒ Click *NO* to come back to the Requirements Form.

8.3 Selecting a particular Requirement

In the Main window, the form view of a particular Requirement can be opened in two different ways:

A. Going through the Forms Menu.

In the Main window, select *Forms Menu* ⇒ *Requirements Form* or press *ALT+O+R.*

In order to find a particular requirement, the following actions can be done:

⇒ Use the arrows for moving among the Requirements currently selected in the form,

To go to the first record of the selected ones,

To go to the previous record to the current one,

To go to the next record to the current one and

To go to the last record of the selected ones

⇒ Use the *Filter button* to filter/un-filter the set of Requirements currently selected in the form,

A new window will appear:

⇒ Click *Data filter activated box* to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be recorded),

⇒ select in the *Field combo box* the desired field to filter the data,

⇒ select in the *Op combo box* how the previously selected field must match the defined *Value* (i.e., "*starting with*", "*contains*", *"is",* "*ending by*")

⇒ write in the *Value Text Field* the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

⇒ define as many filters as wanted (by adding new lines),

⇒ click *Accept*,

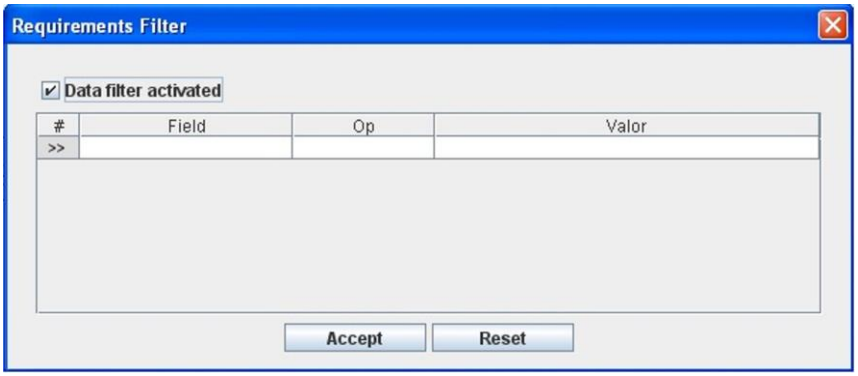


Figure 60: *Requirements Filter to select the desired requirements by different fields*

B. Selecting the Requirement in the Requirements View.

In the Main window, click the *Views Menu* ⇒ *Requirements View* or press *ALT+V+R*.

In order to constrain (by Product Tree Element or by filtering) the number of requirements listed in the view, see the steps to be followed in section 4.2.

Select the desired Requirement among the requirements listed in the table at the right side of the window by double-clicking with the left button of the mouse.

8.4 Modifying existing Requirements

The Requirement to be modified must be already selected, which will be done by following the steps described in section 8.3.

In the Requirements Form, the following steps must be done in order to modify the selected Requirement.

A. Modify the desired fields.

Make the desired changes in the Requirement fields, taking into account all constrains identified in section 8.2, numbered item C).

All the fields in the Requirements Form can be modified.

B. Save the modified record.

In the Requirements Form, click the *Save button* to save the record,

If the record is not saved, the changes will not be applied.

C. Close the Requirements Form

In the Requirements Form, click the *Exit button* to exit the form,

If the record has been saved, the Requirements Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 61: *Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving

⇒ Click *NO* to come back to the Requirements Form.

8.5 Deleting a Requirement

The Requirement to be deleted must be already selected, which will be done by following the steps described in section 8.3.

In the Requirements Form, the following steps must be done in order to delete the selected Requirement.

A. Delete the record.

In the Requirements Form, click the *Delete button* to delete the record,

A new window will appear to ask the user if he/she really wants to delete the record.

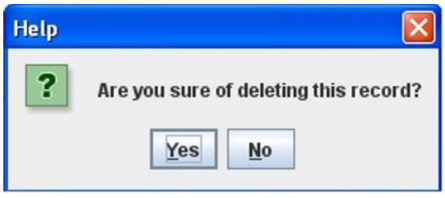


Figure 62: *Warning Window to check if the user wants to delete the record*

⇒ Click *YES* to delete the record.

⇒ Click *NO* to exit without deleting.

8.6 Searching of Requirement's Parents

In the Main window, click the *Tools Menu* ⇒ *Consult requirement's parents* or press *ALT+T+P*.

A new window will appear where the user must, first, introduce the Requirement Code (i.e., the Code of the Requirement whose Parents are going to be searched) and, then, click *Accept*.

Figure 63: *Window to insert the child requirement whose parent requirements have to be found*

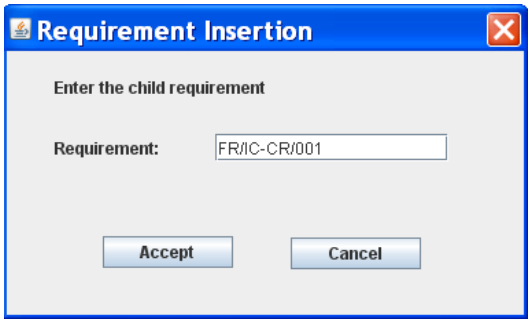


Figure 64: *The child requirement code has to be inserted in the field*

A new window will show the Parents Requirements of the Requirement that has been just introduced.

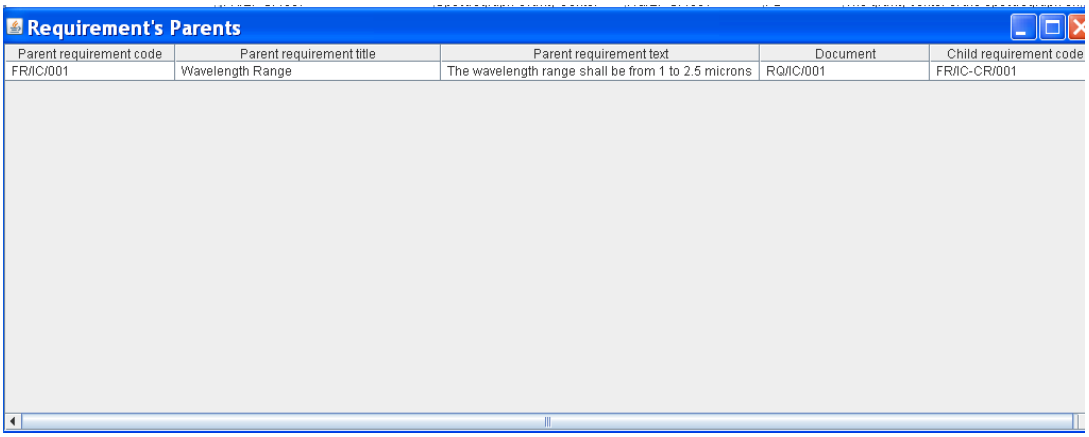


Figure 65: *After entering the child requirement whose parents have to be found, this Window will show the result of the search with all the parent requirements found in the database.*

8.7 Searching of Requirement's Children

In the Main window, click the *Tools Menu* ⇒ *Consult requirement's children* or press *ALT+T+C*.

A new window will appear where the user must, first, introduce the Requirement Code (i.e., the Code of the Requirement whose Childs are going to be search).

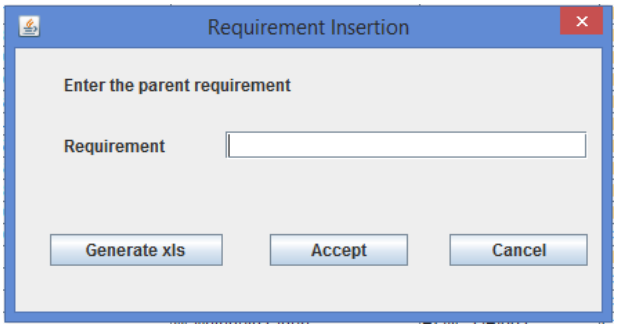


Figure 66: *Window to insert the parent requirement whose child requirements have to be found*

⇒ In the case the user wants the result in xls file, click *Generate xls* button.

A new window will appear where the user must introduce the file name and path to save the xls file, then, click *Accept*.

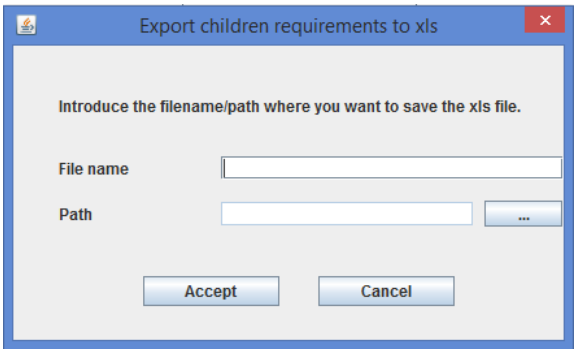
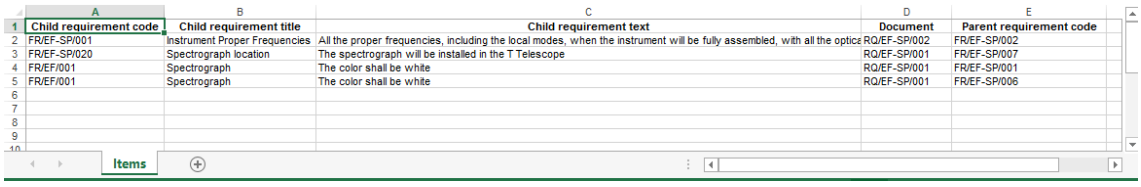


Figure 67: *Window to insert the filename/path to generate the xls file.*

And now, in the previous window (see *Figure 67*) click *Accept*.

A new window (it is necessary to have any xls viewer installed) will show the Children Requirement of the Requirement that has been just introduced. Be aware that only the direct children of the parent requirement will be shown.



	A	B	C	D	E
1	Child requirement code	Child requirement title	Child requirement text	Document	Parent requirement code
2	FR/EF-SP/001	Instrument Proper Frequencies	All the proper frequencies, including the local modes, when the instrument will be fully assembled, with all the optica	RO/EF-SP/002	FR/EF-SP/002
3	FR/EF-SP/020	Spectrograph location	The spectrograph will be installed in the T Telescope	RO/EF-SP/001	FR/EF-SP/007
4	FR/EF/001	Spectrograph	The color shall be white	RO/EF-SP/001	FR/EF-SP/001
5	FR/EF/001	Spectrograph	The color shall be white	RO/EF-SP/001	FR/EF-SP/006
6					
7					
8					
9					
10					

Items

Figure 68: *After entering the parent requirement whose children have to be found, this window will show the result of the search with all the children requirements found in the database.*

⇒ In other case, click *Accept* button.

A new window will show the Children Requirement of the Requirement that has been just introduced. Be aware that only the direct children of the parent requirement will be shown.

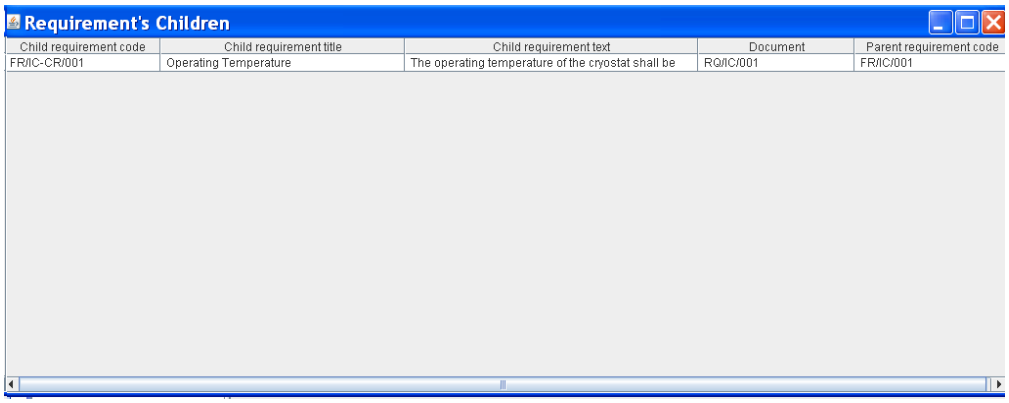


Figure 69: *After entering the parent requirement whose children have to be found, this window will show the result of the search with all the children requirements found in the database.*

8.8 Export requirements to XLS

In the Main window, click the *Tools Menu* ⇒ *Export requirements to XLS*.

A new window will appear where the user must, first, introduce the document, the file name and the path to save the xls file and, then, click *Accept*.

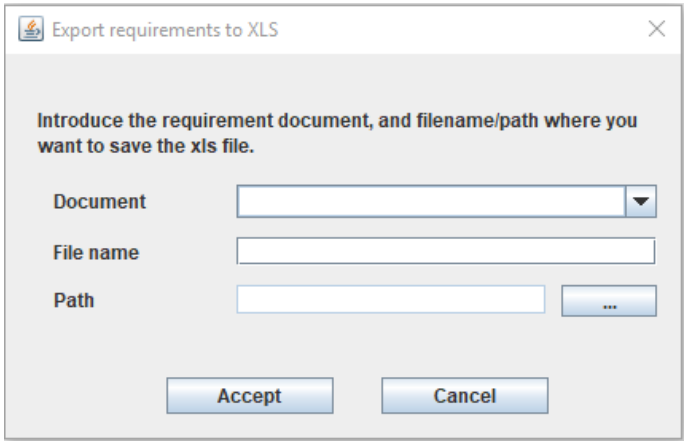


Figure 70: *Window to insert the document and filename/path to generate the xls file*

A new window (it is necessary to have any xls viewer installed) will show a list of all requirements at the document selected.

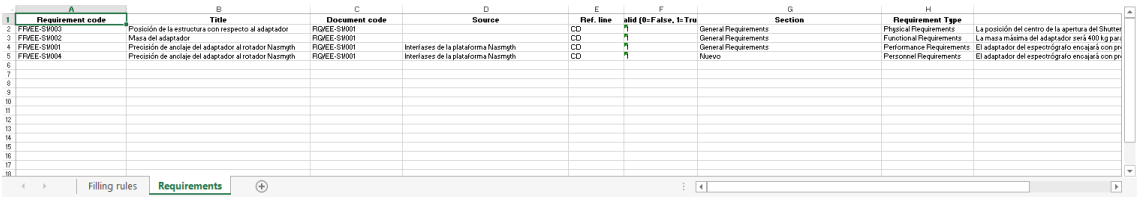


Figure 71: *After entering the document, this window will show the result of the search of all requirements of the selected document found in the database.*

8.9 Import requirements from XLS

The first step to import the requirements of a document is to prepare the xls file that contains the requirement information.

To produce a template of this xls file you only need to export the requirements of the document as explained in the section 8.8. After producing it, follow the instructions included in the template file to fill it in correctly.

In the Main window, click the *Tools Menu* ⇒ *Import requirements from XLS*.

A new window will appear where the user must, first, select the file to be imported and, then, click *Accept*.

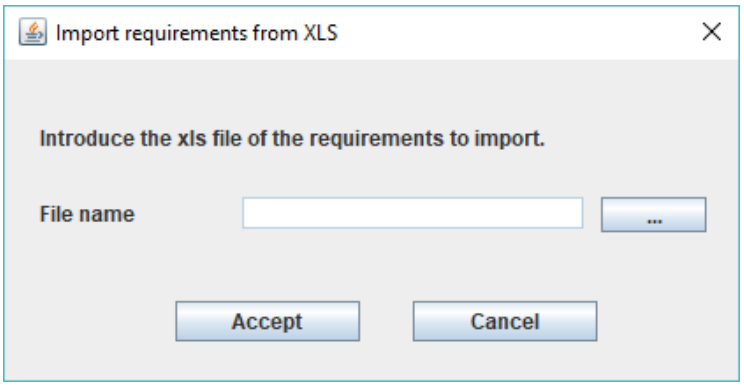


Figure 72: *Window to insert the xls file to import the requirements*

If the requirements import is finished without any error a help window will appear as follow:

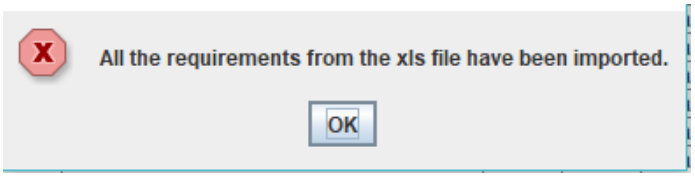


Figure 73: *Import requirement help window*

In any other case, an error window will appear explaining what requirements have not been imported and why.

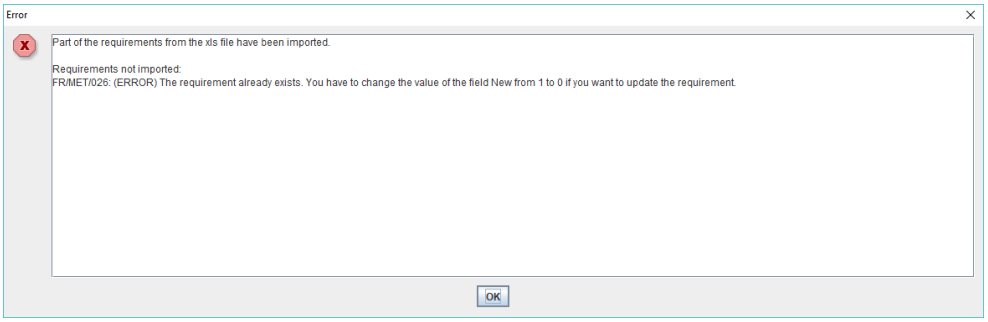


Figure 74: *Import requirement error window*

9. VERIFICATION MATRIX

9.1 What is the Verification Matrix?

The Verification Matrix collects all the information that is going to be generated during the process of verifying the requirements, which includes information such as the planning of the verification tests and the result of these activities.

The Verification Matrix must include all Technical requirements. The Technical requirements describe the design solution of the system, which means that, as soon as the Technical Requirements have been approved, these requirements are going to be implemented and, therefore, they must be verified.

The Verification Matrix provides the status of the system. The user can easily check what requirements have been fulfilled and which ones could compromise the system objectives.

9.2 Exporting Requirements to the Verification Matrix

In the Main window, click the *Tools Menu* ⇒ *Insert requirements into the Verification Matrix* or press *ALT+T+E*.

A new window will appear,

⇒ select in the *Subsystem* combo box the desired Product Tree element Code (i.e., the Code of the Product Tree element which Technical requirements are going to be exported to the Verification Matrix); or in the *Document* combo box the desired Document (i.e., the Code of the requirement document which Technical requirements are going to be exported to the Verification Matrix),

⇒ click *Accept*,

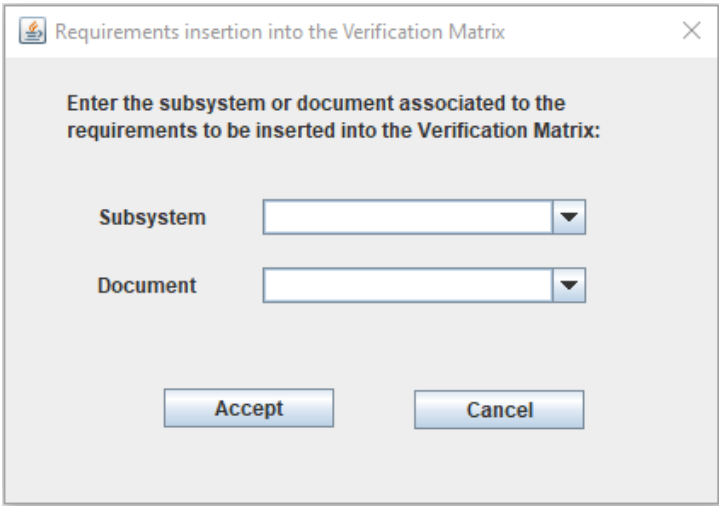


Figure 75: *Window to select the subsystem or requirement document whose requirements have to be inserted into the Verification Matrix.*

The user can check that the desired requirements have been correctly exported in the Verification Matrix View (see section 4.2.1). Please note that the application is exporting all the Technical Requirements of the PT element selected as well as of the lower levels of the PT elements hanging of the one selected, or of the requirement document.

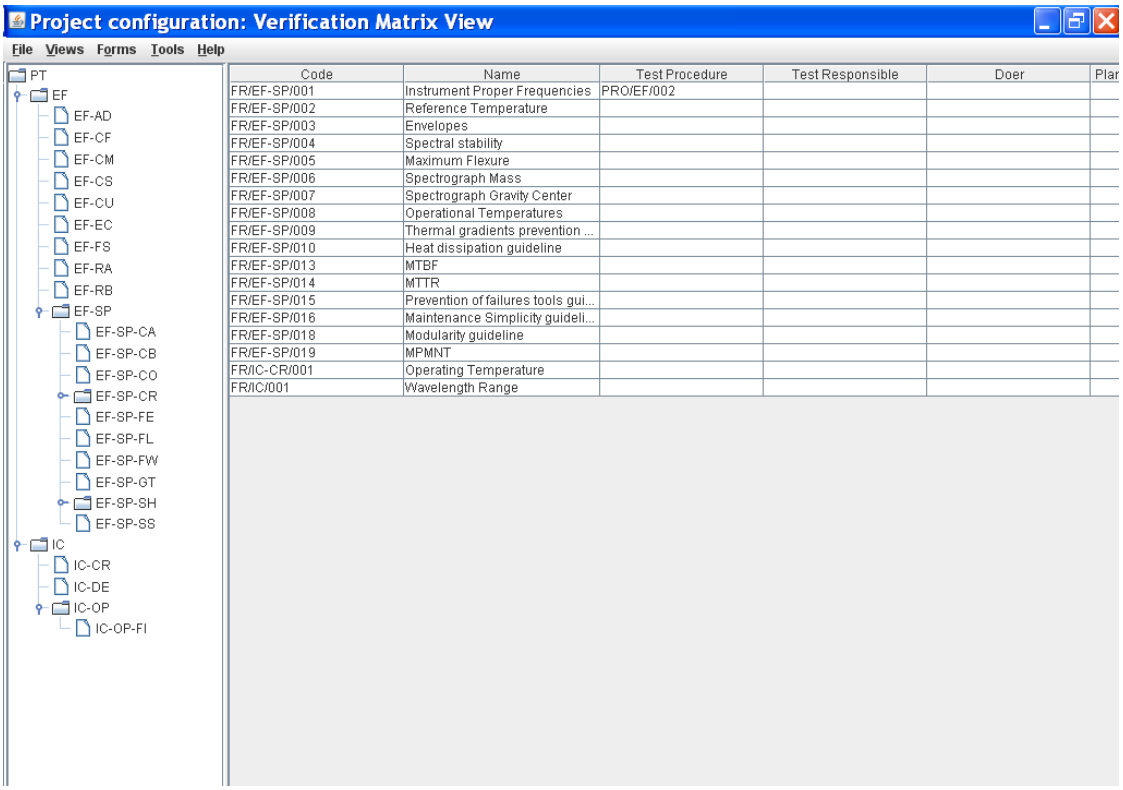


Figure 76: *Verification Matrix View*

9.3 Selecting a particular Requirement in the Verification Matrix

The Requirement Code and Title are displayed in the Verification Matrix Form.

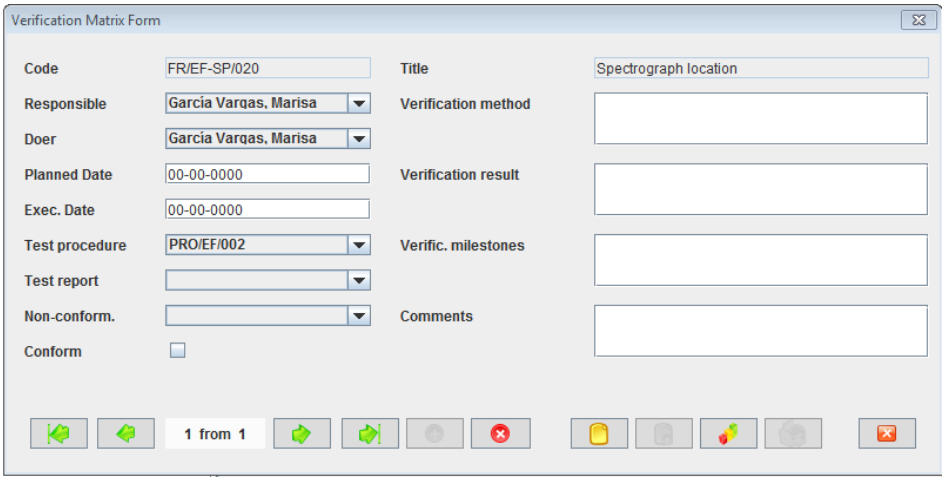


Figure 77: *Verification Matrix Form*

In the Main window, the form view of a particular Requirement in the Verification Matrix can be opened in two different ways:

A. Going through the Forms Menu.

In the Main window, select *Forms Menu* ⇒ *Verification Matrix Form* or press *ALT+O+V*.

In order to find a particular requirement, the following actions can be done:

⇒ Use the arrows for moving among the Requirements currently selected in the Verification Matrix Form,

To go to the first record of the selected ones,

To go to the previous record to the current one,

To go to the next record to the current one and

To go to the last record of the selected ones

⇒ Use the *Filter button* to filter/un-filter the set of Requirements currently selected in the Verification Matrix Form,

A new window will appear:

⇒ Click *Data filter activated box* to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be recorded),

⇒ select in the *Field combo box* the desired field to filter the data,

⇒ select in the *Op combo box* how the previously selected field must match the defined *Value* (i.e., "*starting with*", "*contains*", *"is",* "*ending by*")

⇒ write in the *Value Text Field* the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

⇒ define as many filters as wanted (by adding new lines),

⇒ click *Accept*,

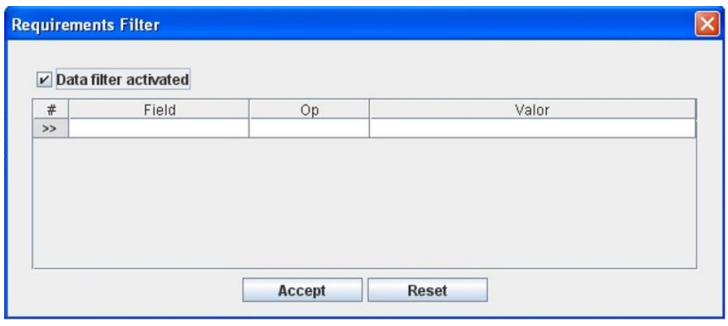


Figure 78: *Requirements Filter to select the desired requirements by different fields*

B. Selecting the Requirement in the Verification Matrix View.

In the Main window, click the *Views Menu* ⇒ *Requirements View* or press *ALT+V+E*.

In order to constrain (by Product Tree Element or by filtering) the number of requirements listed in the view, see the steps to be followed in section 4.2.

Select the desired requirement among the requirements listed in the table at the right side of the window by double-clicking with the left button of the mouse.

9.4 Modifying existing information in the Verification Matrix

The Requirement in the Verification Matrix to be modified must be already selected, which will be done by following the steps described in section 9.3.

In the Verification Matrix Form, the following steps must be done in order to modify the selected Requirement.

A. Modify the desired fields.

Make the desired changes in the Requirement fields:

- **Responsible combo box.** Identify the person responsible to verify the requirements. The persons available in the combo box shall be the ones previously introduced as Users in the application (see section 15).
- **Doer combo box.** Identify the person responsible to execute the test procedure and verify the requirement. The persons available in the combo box shall be the ones previously introduced as Users in the application (see section 15).
- **Planned date.** Indicate the date that has been planned to verify the requirement. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.
- **Execution date.** Indicate the date when the requirement has been verified. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.
- **Test procedure combo box.** Identify the procedure (if any) that has been previously defined to be followed during the verification of the requirement. In the combo box, all Procedures (PRO/…) documents existing in the application will be accessible.
- **Test report combo box.** Identify the report (if any) that has been generated after the test that has been executed to verify the requirement. In the combo box, all Reports (RPT/…) documents existing in the application will be accessible.
- **Non-conformity combo box.** If the requirement has not been verified, a non-conformity could be raised to track and analyze the problem. In the combo box, all Non-conformities existing in the application will be accessible.
- **Conform.** Indicate if the requirement has been verified or not, which means that the requirement complies or not with the requirement text. By default, the requirements have not been verified yet and, therefore, they do not appear as “Conform”.

- **Verification method.** Describe the method that is going to be used to verify the requirement. This is a text field with a maximum length of 3000 characters.
- **Verification result.** Describe the result of the test that has been executed to verify the requirement. This is a text field with a maximum length of 3000 characters.
- **Verification milestones.** Describe the milestones to verify the requirement. This is a text field with a maximum length of 255 characters.
- **Comments box.** Describe any additional comments related to the verification test to be done or already executed. This is a text field with a maximum length of 255 characters.

B. Save the modified record.

In the Verification Matrix Form, click the *Save button* to save the record,

If the record is not saved, the changes will not be applied.

C. Close the Verification Matrix Form

In the Verification Matrix Form, click the *Exit button* to exit the form,

If the record has been saved, the Verification Matrix Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 79: *Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving.

⇒ Click *NO* to come back to the Verification Matrix Form.

9.5 Deleting a Requirement in the Verification Matrix

The Requirement to be deleted must be already selected, which will be done by following the steps described in section 9.3.

In the Verification Matrix Form, the following steps must be done in order to delete the selected Requirement.

A. Delete the record.

In the Verification Matrix Form, click the *Delete button* to delete the record,

A new window will appear to ask the user if he/she really wants to delete the record.

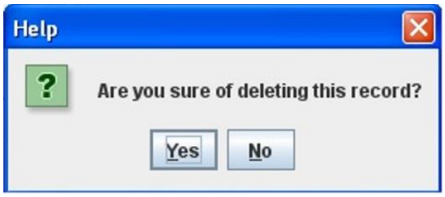


Figure 80: *Warning Window to check if the user wants to delete the record*

⇒ Click *YES* to delete the record.

⇒ Click *NO* to exit without deleting.

9.6 Verification Matrix Summary View

In the Main window, click the *Tools Menu* ⇒ *Verification Matrix summary view* or press *ALT+T+V*.

A new window will appear where the user must, first, introduce the subsystem or the requirement document, and the file name and path to save the pdf file, then, click *Accept*.

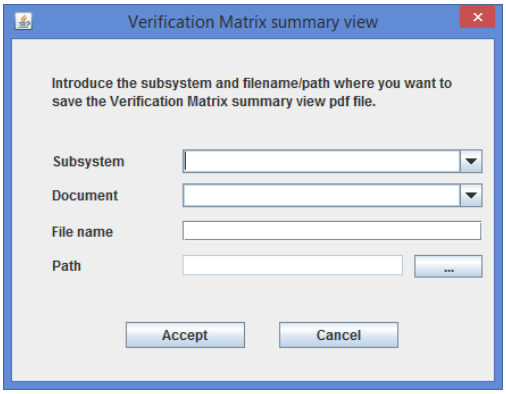
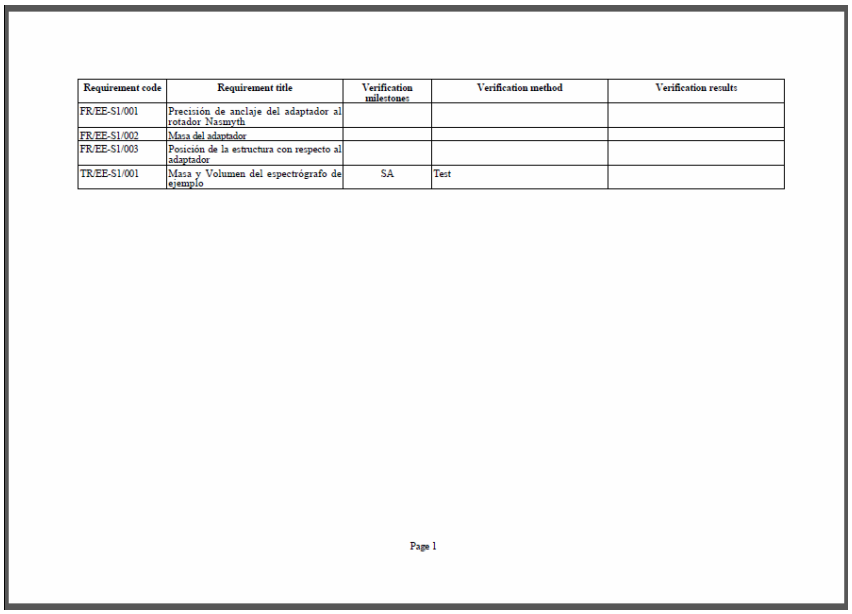


Figure 81: *Window to insert the subsystem or requirement document, and filename/path to generate the pdf file*

A new window (it is necessary to have installed any pdf viewer) will show a summary view of the verification matrix elements of the subsystem and lower level elements or of the requirement document that has been just introduced.



Requirement code	Requirement title	Verification milestones	Verification method	Verification results
FR/EE-S1/001	Precisión de anclaje del adaptador al rotador Nasmyth			
FR/EE-S1/002	Masa del adaptador			
FR/EE-S1/003	Posición de la estructura con respecto al adaptador			
TR/EE-S1/001	Masa y Volumen del espectrógrafo de ejemplo	SA	Test	

Page 1

Figure 82: *After entering the subsystem, this window will show the result of the search with all the verification matrix elements of this subsystem and lower level elements or of requirement document found in the database.*

9.7 Export Verification Matrix to XLS

In the Main window, click the *Tools Menu* ⇒ *Export Verification Matrix to XLS*.

A new window will appear, where the user must, first, introduce the subsystem or requirement document, the file name and path to save the xls file and, then, click *Accept*.

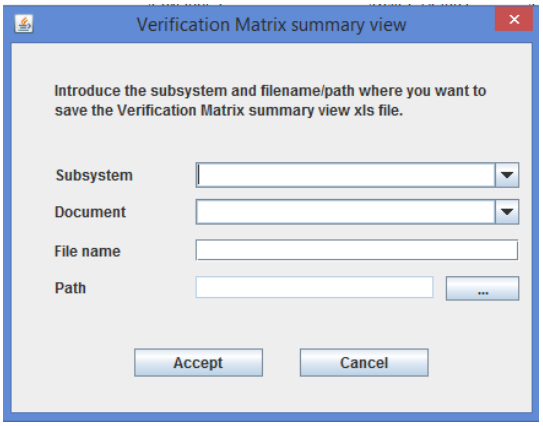
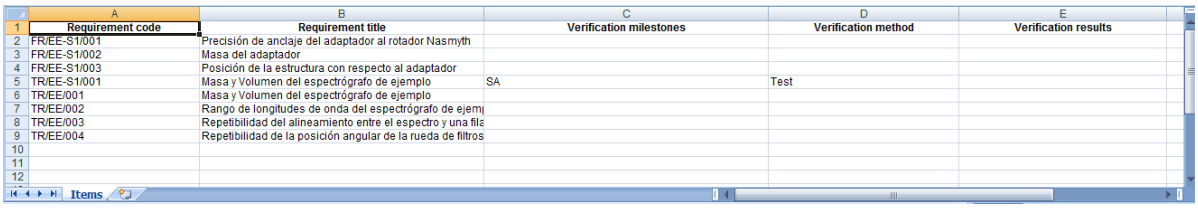


Figure 83: *Window to insert the subsystem or requirement document, and filename/path to generate the xls file*

A new window (it is necessary to have installed a xls viewer) will show the verification matrix elements of the subsystem (and lower level elements below this subsystem) or of the requirement document that has been just introduced.



	A	B	C	D	E
1	Requirement code	Requirement title	Verification milestones	Verification method	Verification results
2	FR/EE-S1/001	Precisión de anclaje del adaptador al rotador Nasmyth			
3	FR/EE-S1/002	Masa del adaptador			
4	FR/EE-S1/003	Posición de la estructura con respecto al adaptador			
5	TR/EE-S1/001	Masa y Volumen del espectrógrafo de ejemplo	SA	Test	
6	TR/EE/001	Masa y Volumen del espectrógrafo de ejemplo			
7	TR/EE/002	Rango de longitudes de onda del espectrógrafo de ejem			
8	TR/EE/003	Repetibilidad del alineamiento entre el espectro y una fila			
9	TR/EE/004	Repetibilidad de la posición angular de la rueda de filtros			
10					
11					
12					

Items

Figure 84: *After entering the subsystem or requirement document, this window will show the result of the search, which will include all verification matrix elements found in the database for the selected subsystem (and lower level elements below this subsystem) or for the selected requirement document.*

9.8 Import Verification Matrix from XLS

The first step to import the verification matrix is to prepare the xls file that provides the verification matrix template and contains verification matrix information.

To produce a template of this xls file you only need to export the verification matrix as explained in the section 9.7. After producing it, follow the instructions included in the template file to fill it in correctly.

In the Main window, click the *Tools Menu* ⇒ *Import verification matrix from XLS*.

A new window will appear where the user must, first, select the file to be imported and, then, click *Accept*.

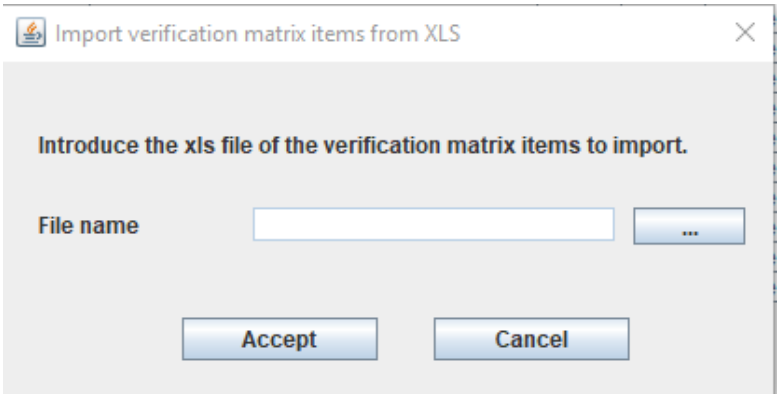


Figure 85: *Window to insert the xls file to import the verification matrix*

If the requirements import is finished without any error a help window will appear as follow:

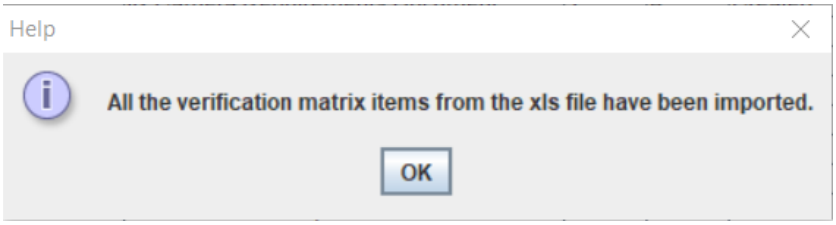


Figure 86: *Import verification matrix help window*

In any other case, an error window will appear explaining what requirements have not been imported and why.

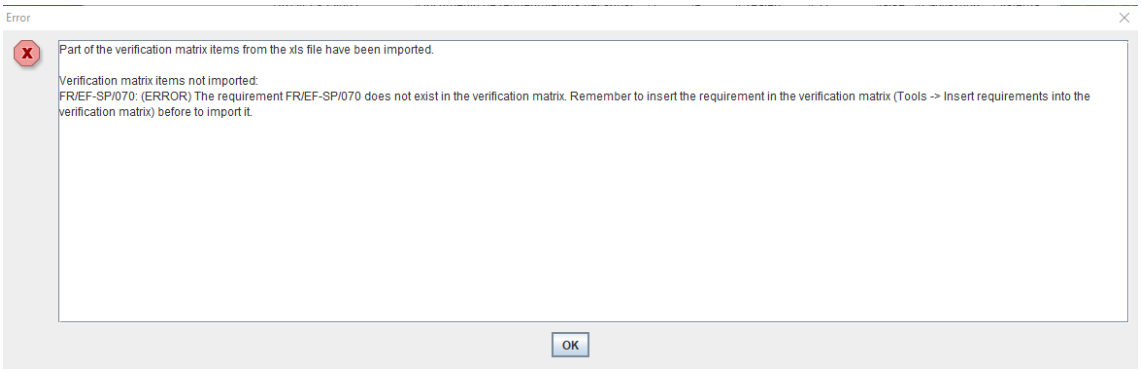


Figure 87: *Import verification matrix error window*

10. DOCUMENTS

10.1 What is a Document?

A Document is commonly defined as a writing that contains information.

In any organization, there are a lot of different documents that must be generated and kept. Not only technical documents such as Requirement or Specification documents, Drawings, Reports, Analysis, Procedures, etc. but, also, formal documents such as Contracts, Intentions to Tender, Statement of Work documents, etc.

GECO provides the means to organize, to classify and to access all these documents[1].

10.2 Creating a new Document

Starting at the Main Window of the application,

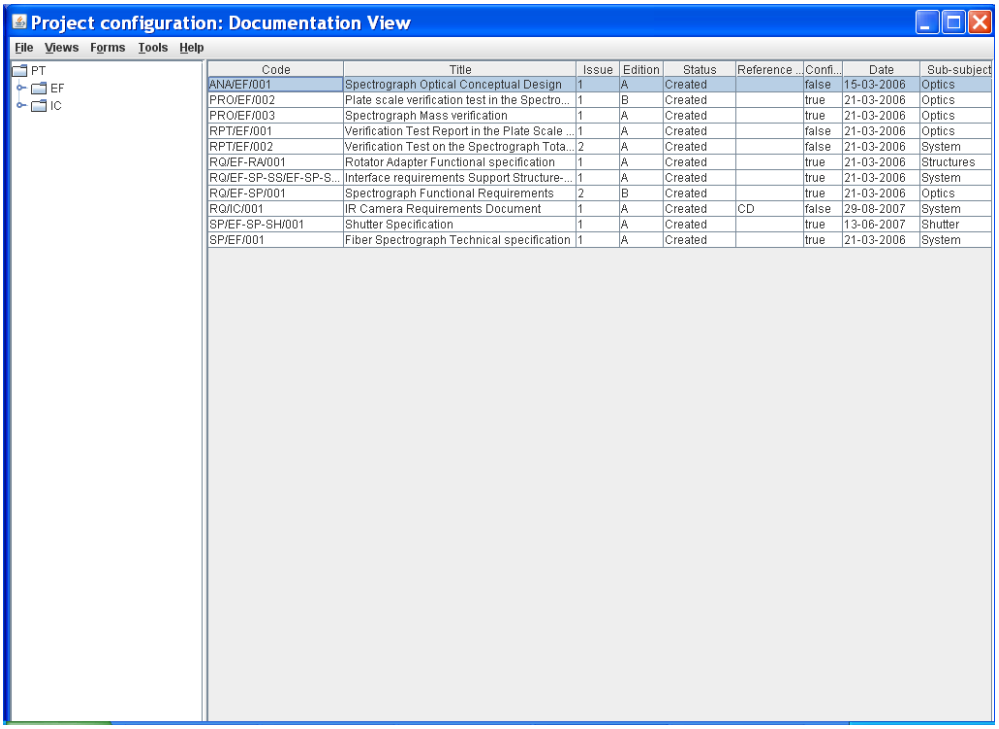


Figure 88: *Main window of the application*

The following steps must be executed in order to create a new Document:

A. Open the Documents Form.

In the Main window, the Documents Form can be opened in two different ways:

[1] It is important to mention that the documents themselves are not stored in the Database, only the information about them, including the link. So, the Database back-ups do not manage the documents back-ups, that must be done independently.

Going through the Forms Menu.

In the Main window, select *Forms Menu* ⇒ *Documents Form* or press *ALT+O+D*.

The Documents Form will be opened with all available records selected.

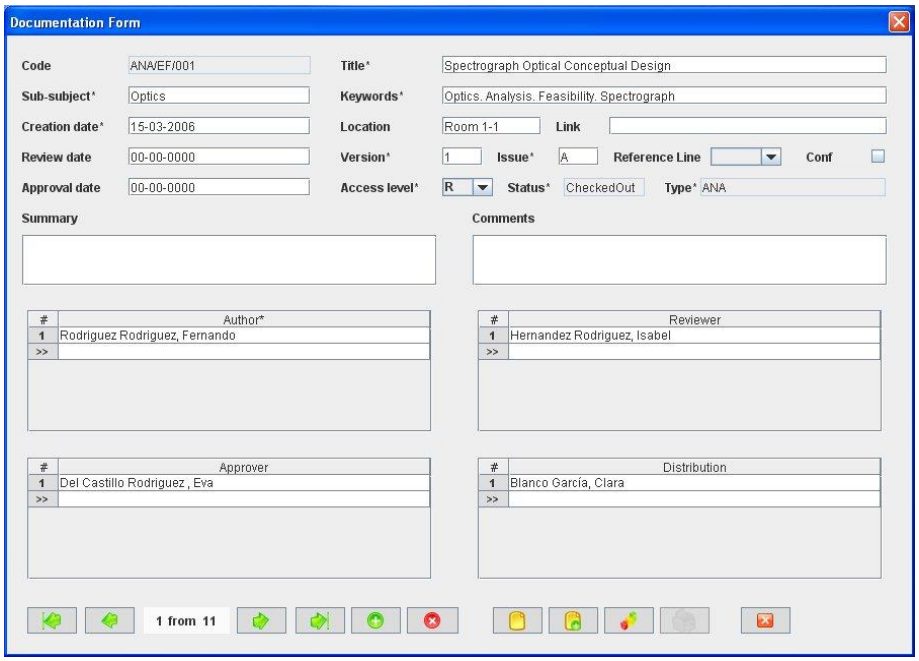


Figure 89: *Documents Form showing all the selected records*

A.I. Selecting a Document in the Documents View.

In the Main window, click the *Views Menu* ⇒ *Documents View* or press *ALT+V+D*.

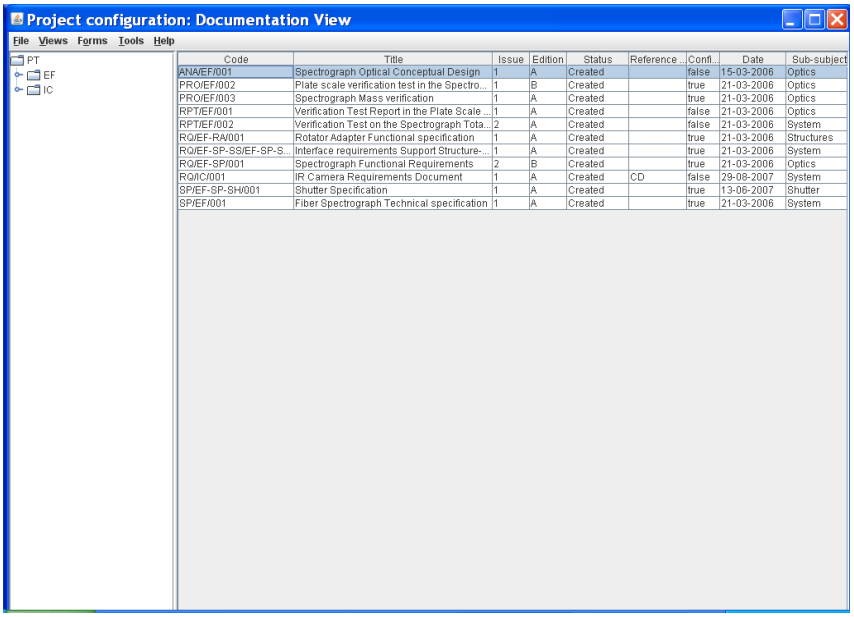


Figure 90: *Documents View (right panel) showing all the selected document associated to the selected PT element (left panel)*

Select a Document among the Documents listed in the table at the right side of the window by double-clicking with the left button of the mouse.

The Documents Form will be opened only with the selected record available.

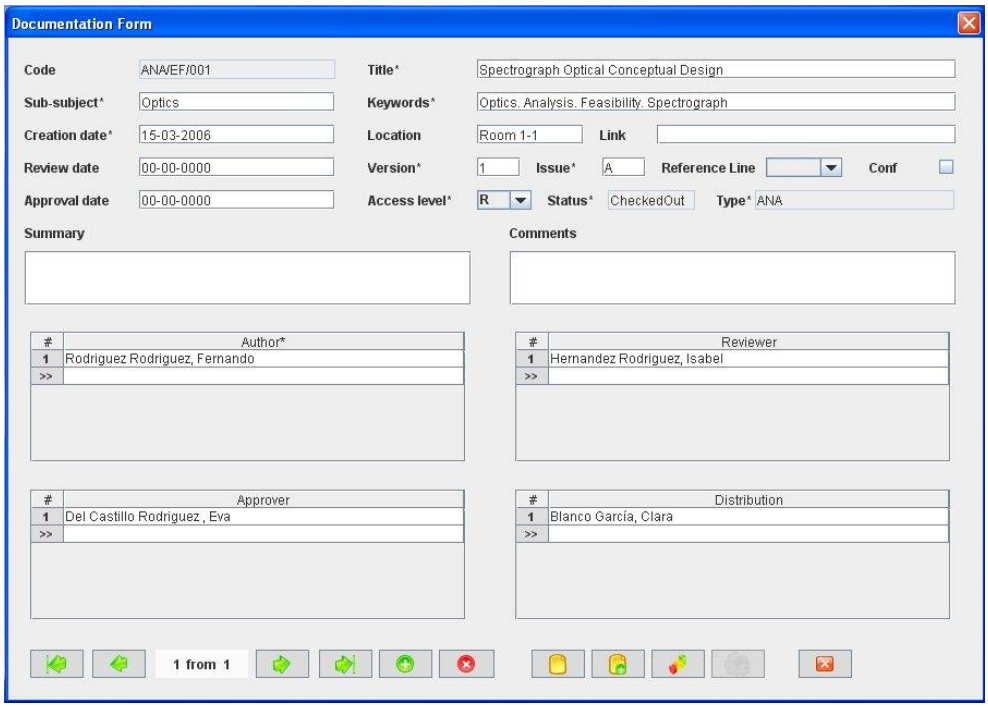


Figure 91: *Documents Form showing only the selected record*

B. Add a new record.

In the Documents Form, new Documents can be created in two different ways:

B.I. Starting an empty Document.

In the Documents Form, click the *Add button* to add a new record,

A new window will appear,

⇒ select the document type in the *Document Type combo box*,

⇒ select the Product Tree or Interface code in the *PT Element or interface combo box*,

⇒ click *Accept*,

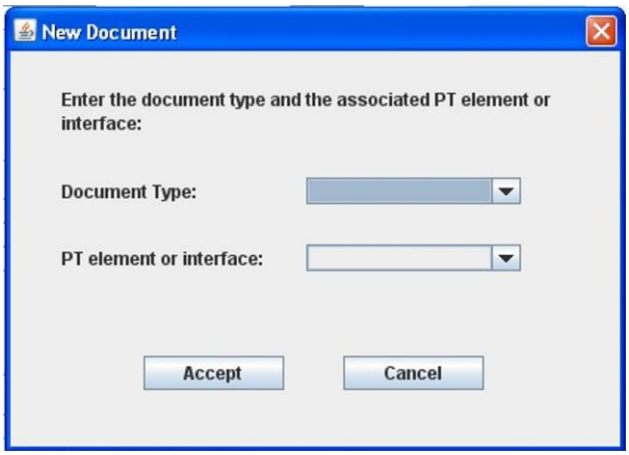


Figure 92: *Documents Form*

The new Document **Code** will be automatically generated as the first one available for the Document type and Product Tree or Interface code selected.

All Document Codes follow the same pattern as described below:

TT/PT/nnn

where,

TT: Document type, which include the following options:

- Analysis (ANA)
- Drawing (DR)
- Interface (INT)
- Minutes of Meeting (MOM)
- Procedure (PRO)
- Report (RPT)
- Requirement document (RQ)
- Specification document (SP)
- Technical note (TEN)

PT: Product Tree Element or Interface code

nnn: Sequence number that will be automatically generated by the application

The Document Code is unique for each document.

The Document Code convention is defined before starting to use GECO. More information about it can be found in section 18.

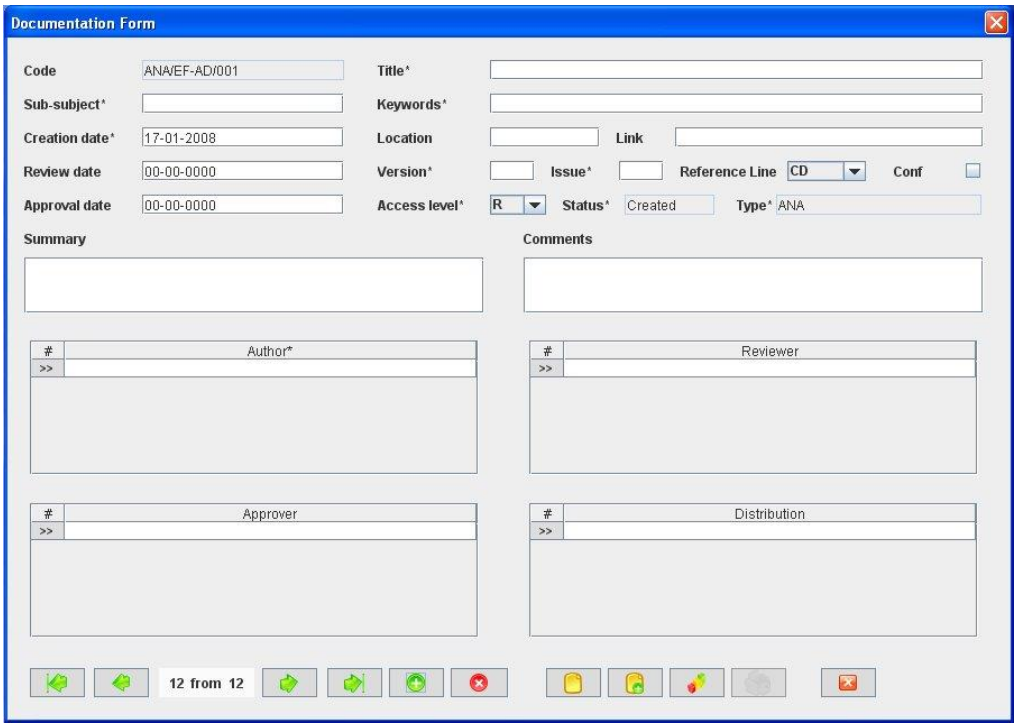


Figure 93: *Documents Form once the PT element or interface and the document type has been chosen as shown in Figure 92*

B.II. Cloning an already existing Document.

In the Documents Form, click the *Copy button* to clone the document that is currently selected in the form,

The new Document **Code** will be automatically generated as the first one available for the same Document type and Product Tree or Interface code of the Document that has been cloned.

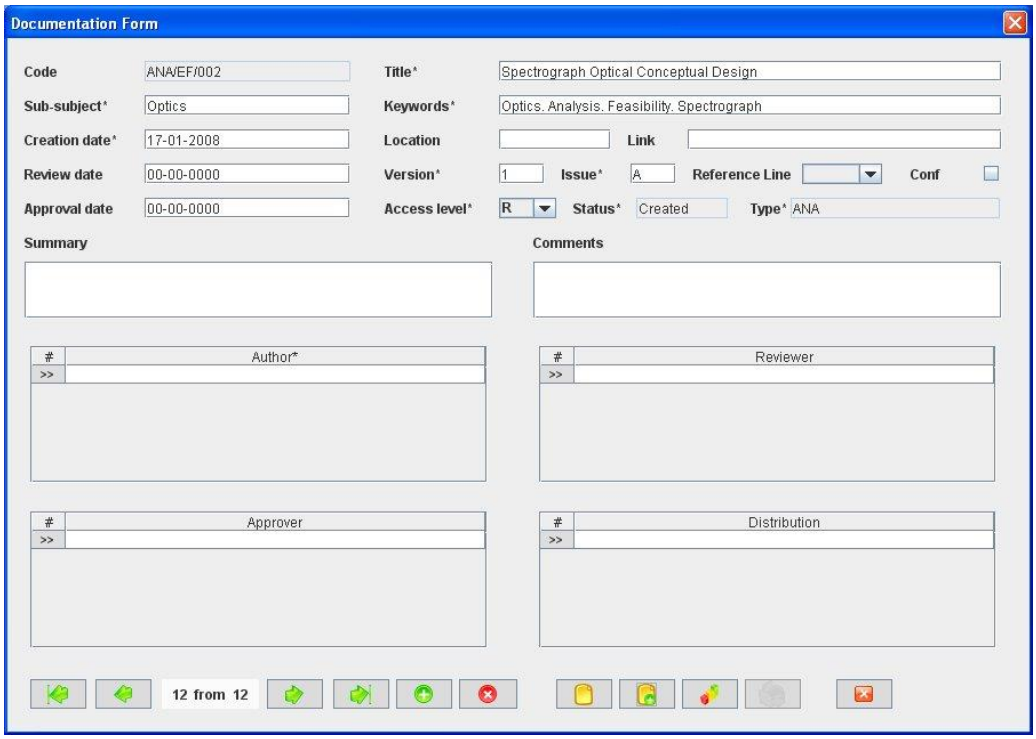


Figure 94: *Documents Form ready to introduce a new document by cloning an existing record*

C. Fill in the new record.

In the Document Form, the mandatory fields that must be filled in are the following ones:

- **Code.** The Document code is automatically generated by the application, but it can be modified by the user. If so, the application will check that there is no other document with the same code before the record is saved. This is a text field with a maximum length of 60 characters.
- **Title.** The title of the document should describe in the shortest and more concise way possible the objective of the document. This is a text field with a maximum length of 255 characters.
- **Sub-subject.** Indicate what subsystem (or group inside the organization) is in charge of creating and maintaining the document. This is a text field with a maximum length of 20 characters.
- **Keywords.** Include the main keywords of the document (i.e., the words that best describe the content of the documents). This field could help whenever the user is looking for this document or looking for documents applicable to a certain concept. This is a text field with a maximum length of 250 characters.
- **Creation date.** Indicate the date when the document has been initially created. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.
- **Version.** Indicate the version number of the document. This is a text field with a maximum length of 5 characters.

- **Issue.** Indicate the issue number of the document. This is a text field with a maximum length of 5 characters.
- **Access level combo box.** Select the access level policy associated with the document among the options offered in the access level combo box, which includes the following ones:
    - *R* (Restricted access)
    - *P* (Public access)
    - *L* (Limited access)

  By default, the access level is defined as *"R"*.
- **Status.** Indicate the current situation of the document. This is a text field with a maximum length of 20 characters. By default, the status is always "*Created*". This field has been introduced to make GECO compatible with other tools of the Fractal Projects Suite, in particular with the Documentation Management Tool, DOCMA.
- **Type combo box.** This field has been defined at the document creation and cannot be modified.
- **Author.** Identify the authors of the document (as many as desired). The persons available in the combo box shall be the ones previously introduced as Users in the application (see section 15).

The rest of the fields that can be optionally filled are:

- **Review date.** Indicate the date when the revision of the document has been finished. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.
- **Reference line combo box.** Select the reference line of the document among the options offered in the Reference line combo box, which includes the following ones:
    - *CD* (Conceptual Design line)
    - *PD* (Preliminary Design line)
    - *DD* (Detailed Design line)
    - *PDR* (Product line)

  By default, the privacy is defined as *"CD"*.
- **Conf.** Indicate if the document is a configuration document or not. By default, all documents are not "configuration document" (i.e., the tick is not marked).
- **Approval date.** Indicate the date when the document has been finally approved. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.
- **Summary.** Describe briefly the content of the document. This is a text field with a maximum length of 300 characters.

- **Comments.** Introduce any additional comment related to the document. This is a text field with a maximum length of 60 characters.
- **Location.** Indicate where the document is physically stored. This is a text field with a maximum length of 100 characters.
- **Link.** It is possible to create a link to the directory where the electronic copy of the document is stored. This is a text field with a maximum length of 255 characters.
- **Reviewer.** Identify the reviewers of the document (you can select as many persons as desired). The persons available in the combo box shall be the ones previously introduced as Users in the application (see section 15).
- **Approver.** Identify the approvers of the document (you can select as many persons as desired). The persons available in the combo box shall be the ones previously introduced as Users in the application (see section 15).
- **Distribution.** Identify to which persons the document must be distributed (you can select as many persons as desired). The persons available in the combo box shall be the ones previously introduced as Users in the application (see section 15).
- **Notification.** Identify the persons that must be notified of the creation or new versions of the document (you can select as many persons as desired). The persons available in the combo box shall be the ones previously introduced as Users in the application (see section 15).

D. Save the new record.

In the Documents Form, click the *Save button* to save the record,

If the current record is not saved, the new record will not be created.

E. Close the Requirements Form

In the Documents Form, click the *Exit button* to exit the form,

If the record has been saved, the Documents Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 95: *Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving

⇒ Click *NO* to come back to the Documents Form.

10.3 Selecting a particular Document

In the Main window, the form view of a particular Document can be opened in two different ways:

A. Going through the Forms Menu.

In the Main window, select *Forms Menu* ⇒ *Documents Form* or press *ALT+O+D*.

In order to find a particular document, the following actions can be done:

⇒ Use the arrows for moving among the documents currently selected in the form,

To go to the first record of the selected ones,

To go to the previous record to the current one,

To go to the next record to the current one and

To go to the last record of the selected ones

⇒ Use the *Filter button* to filter/un-filter the set of documents currently selected in the form,

A new window will appear:

⇒ Click *Data filter activated box* to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be recorded),

⇒ select in the *Field combo box* the desired field to filter the data,

⇒ select in the *Op combo box* how the previously selected field must match the defined *Value* (i.e., "*starting with*", "*contains*", *"is"*, "*ending by*")

⇒ write in the *Value Text Field* the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

⇒ define as many filters as wanted (by adding new lines),

⇒ click *Accept*,

Figure 96: *Documents Filter to select the desired documents by different fields*

B. Selecting the Document in the Documents View.

In the Main window, click the *Views Menu* ⇒ *Documents View* or press *ALT+V+D.*

In order to constrain (by Product Tree Element or by filtering) the number of documents listed in the view, see the steps to be followed in section 4.2.

Select the desired document among the documents listed in the table at the right side of the window by double-clicking with the left button of the mouse.

10.4 Modifying existing Document

The document to be modified must be already selected, which will be done by following the steps described in section 10.3.

In the Documents Form, the following steps must be done in order to modify the selected Document.

A. Modify the desired fields.

Make the desired changes in the Document fields, taking into account all constrains identified in section 10.2, numbered item C).

All the fields in the Documents Form can be modified.

B. Save the modified record.

In the Documents Form, click the *Save button* to save the record,

If the record is not saved, the changes will not be applied.

C. Close the Documents Form

In the Documents Form, click the *Exit button* to exit the form,

If the record has been saved, the Documents Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 97: *Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving.

⇒ Click *NO* to come back to the Documents Form.

10.5 Deleting a Document

The Document to be deleted must be already selected, which will be done by following the steps described in section 10.3.

In the Documents Form, the following steps must be done in order to delete the selected Document.

B. Delete the record.

In the Documents Form, click the *Delete button* to delete the record,

A new window will appear to ask the user if he/she really wants to delete the record.

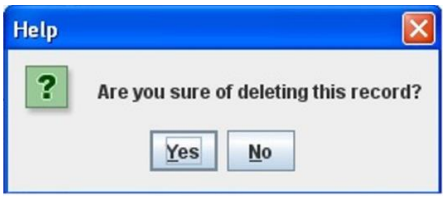


Figure 98: *Warning Window to check if the user wants to delete the record*

⇒ Click *YES* to delete the record.

⇒ Click *NO* to exit without deleting.

10.6 Exporting Requirements into a Document

All requirements have as a mandatory field the Requirements or Specifications Document where they are going to be grouped. Therefore, the Requirement or Specification Document must have been already created even before entering a requirement and, of course, before trying to export the requirements to the Document.

Whenever the user wants to export the requirements to the Document, the following steps must be done.

A. Select a Document.

In the Main window, click the *Views Menu* ⇒ *Documents View* or press *ALT+V+D.*

Select the Document whose requirements are going to be exported (i.e., all Requirements that has this particular document in their *Document* field will be selected).

Once the Document is selected, click the *Tools Menu* ⇒ *Exporting Requirements to XML* or *press ALT+T+E*.

If the Document selected is a Requirement or Specification Document, the following window will appear:

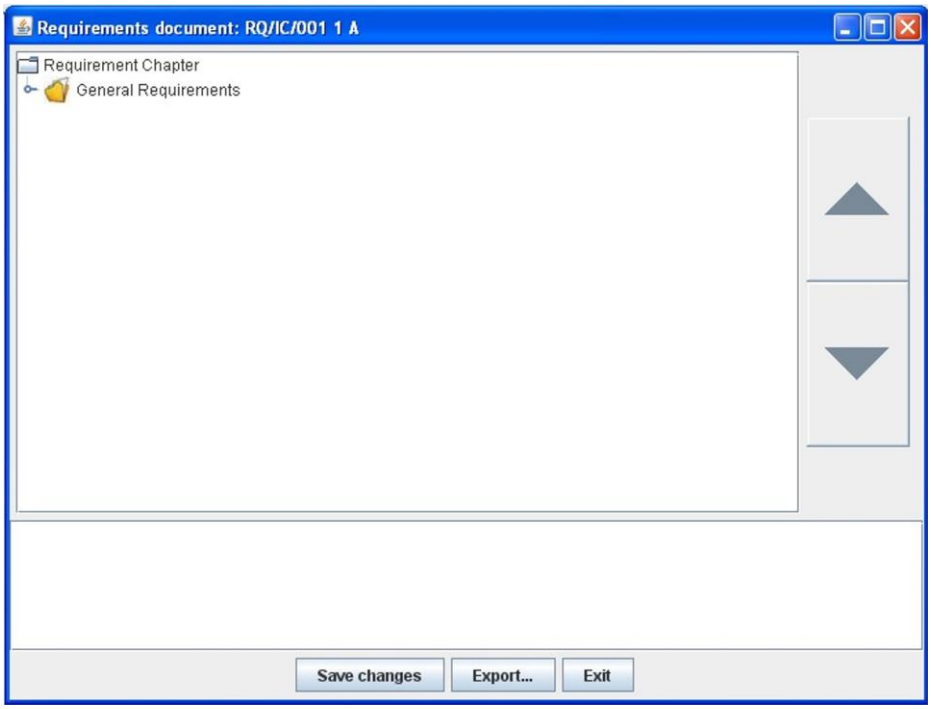


Figure 99: *Exporting Requirements Window*

If the Document is not a Requirement or Specification Document, an error message will indicate it to the user.

B. Organize the Requirements.

The sections, subsections and requirements order in the document will be as shown in the window tree (click the small blue key to open the section and subsections). The order can be changed by doing the actions indicated in the following steps:

⇒ Select the section, subsection or requirement whose relative position in the Tree is going to be changed by clicking with the left button of the mouse.

⇒ Use the corresponding arrows (in the right side of the window) to move the selected item up and down as shown in the figure.

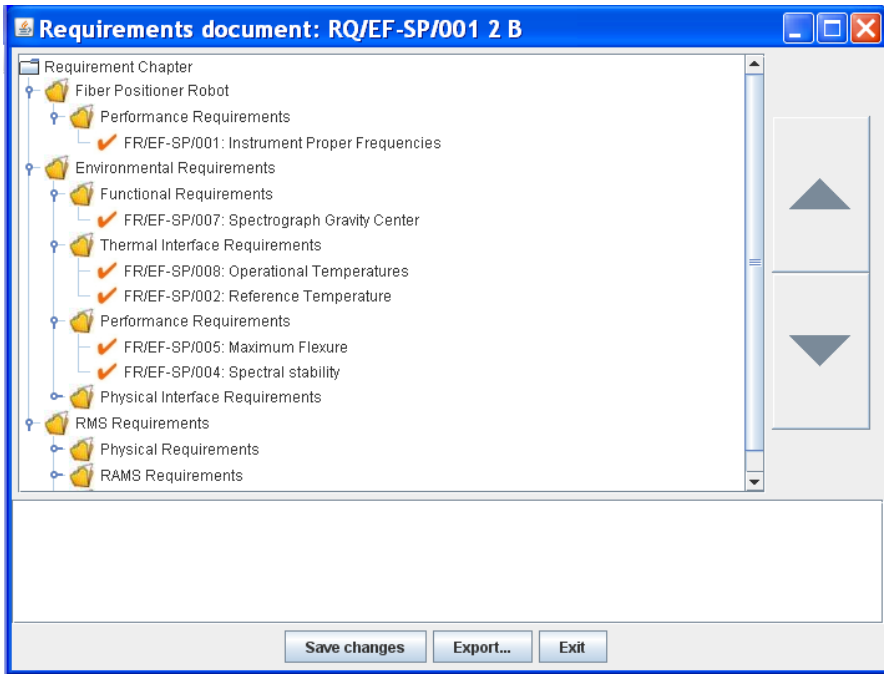


Figure 100: *Sections and Subsections are opened in the Exporting Requirements Window, the order of the sections, subsections and requirements can be modified*

⇒ Repeat the previous steps as many times as needed in order to organize the sections, subsections and requirements order.

C. Save the changes done in the requirements organization.

In order to save the changes done in the section, subsections and requirements order, click the *Save button*.

D. Export the Requirements to the document.

In order to export the requirements to the document, click the *Export button*.

The following window will appear:

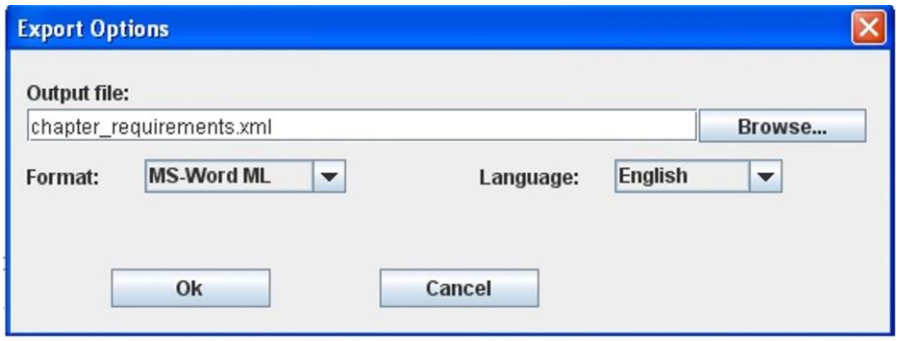


Figure 101: *Generating the XML Files Window*

⇒ Indicate the name of the document in the *Output file* field.

⇒ Select the Folder to save the document using the *Browse ...* button.

⇒ Select the Format of the output file in the *Format* combo box, which offers two options:

- MS-Word ML: The output file is an MS-Word XML file, which can be inserted in the Requirements section of the corresponding Requirement or Specification Document.

- Req ML: The output file is an XML file, which follows a pattern as shown in the example below:

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<RequirementSet>
<Section Name="General Requirements">
      <Subsection Name="Performance Requirement">
            <Requirement Code="FR/IC/001" Title="Wavelength
            Range">
                  <Source>Instrumentation Group</Source>
                  <Description>The wavelength range shall
                  be from 1 to 2.5 microns</Description>
            </Requirement>
      </Subsection>
      <Subsection Name="Environmental Requirement">
            <Requirement Code="FR/IC-CR/001"
            Title="Operating Temperature">
                  <ParentReqSet>
                        <PR Code="FR/IC/001"/>
                  </ParentReqSet>
                  <Source>Instrumentation Group</Source>
                  <Description>The operating temperature of
                  the cryostat shall be 77K</Description>
            </Requirement>
      </Subsection>
</Section>
</RequirementSet>
```

⇒ Select the language of the output file in *Language* combo box. The options are: English and Spanish. The language is only applicable if the file to be created is an MS-Word ML file. According to the language selected, the labels Source and Parent requirements shall be included in the xml file in English or Spanish.

⇒ Select *Accept*.

E. Close the Exporting Requirements to XML window.

In order to exit of the Exporting Requirement to XML window, click the *Exit* button.

If the changes have not been saved, the changes will not be applied.

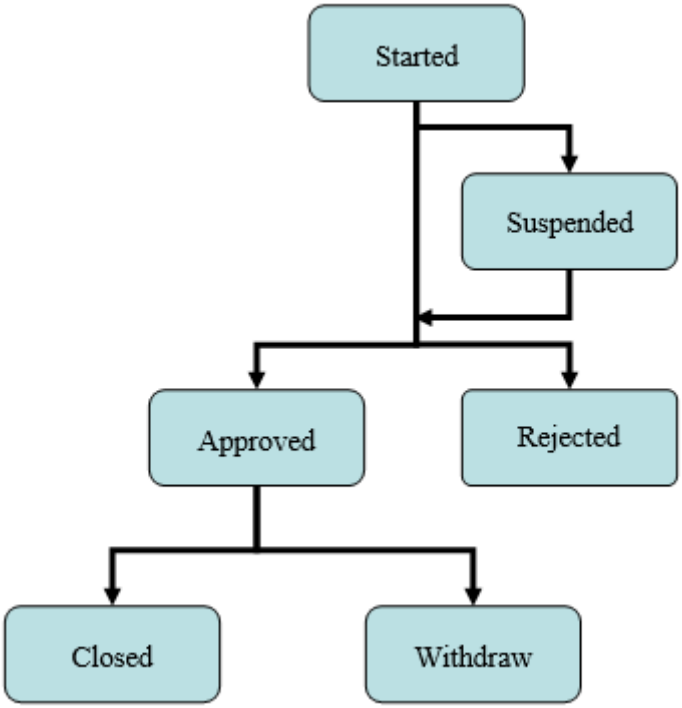
11. CONFIGURATION CHANGES

11.1 What is a Configuration Change?

A Configuration Change is a formal request to modify the current configuration of the system. The current configuration of the system, which can also be referred as the configuration baseline, is defined by the approved status of the design of the system at a particular project milestone.

The Product Tree elements, Interfaces, Requirements and Drawings are all part of the system configuration. So, any change to these elements, once they have been approved whenever a particular project milestone (i.e., Conceptual Design Review, Preliminary Design Review …) has been successfully reached, cannot be done before a Configuration Change is requested and approved.

The Configuration Changes follow a life-cycle as shown in the figure:



This life-cycle can be briefly summarized in the following steps:

- In the first place, the Configuration Change must be introduced in the application. All relevant information related to this particular Configuration Change must be identified to allow the CRB (Configuration change Review Board) evaluates correctly the implications of the change. At that point, the Configuration Change status is *"Started"*.
- In the CRB meeting, the Configuration Change is analyzed and the Configuration Change state can be changed to *"Approved"* or *"Rejected"* depending of the board decision. Alternatively, if any lack of information is found, the Configuration Change Board can decide to classify the change as *"Suspended"* and to wait for the Initiator to clarify the doubts before evaluating the Configuration Change again.

- If the Configuration Change were approved, the people who has initiated the Configuration Change must carry out the corresponding actions and inform the Configuration Management Team if the Configuration Change can be *"Closed"* or *"Withdrawn"* (if, for any reason, the Configuration Change cannot be finally implemented):

GECO provides the support to manage and archive the Configuration Changes. In this sense, all the relevant information generated during the Configuration Change life-cycle, can be introduced and maintained in the application. GECO will also help in the Configuration Change coordination and information distribution by sending emails at the most important Configuration Change life-cycle transitions.

Finally, in order to understand the importance of having the Configuration Change information easily accessible, it is useful to mention that the current configuration of a system is composed by the approved Configuration Elements and the Configuration Changes.

11.2 Creating a new Configuration Change

Starting at the Main Window of the application,

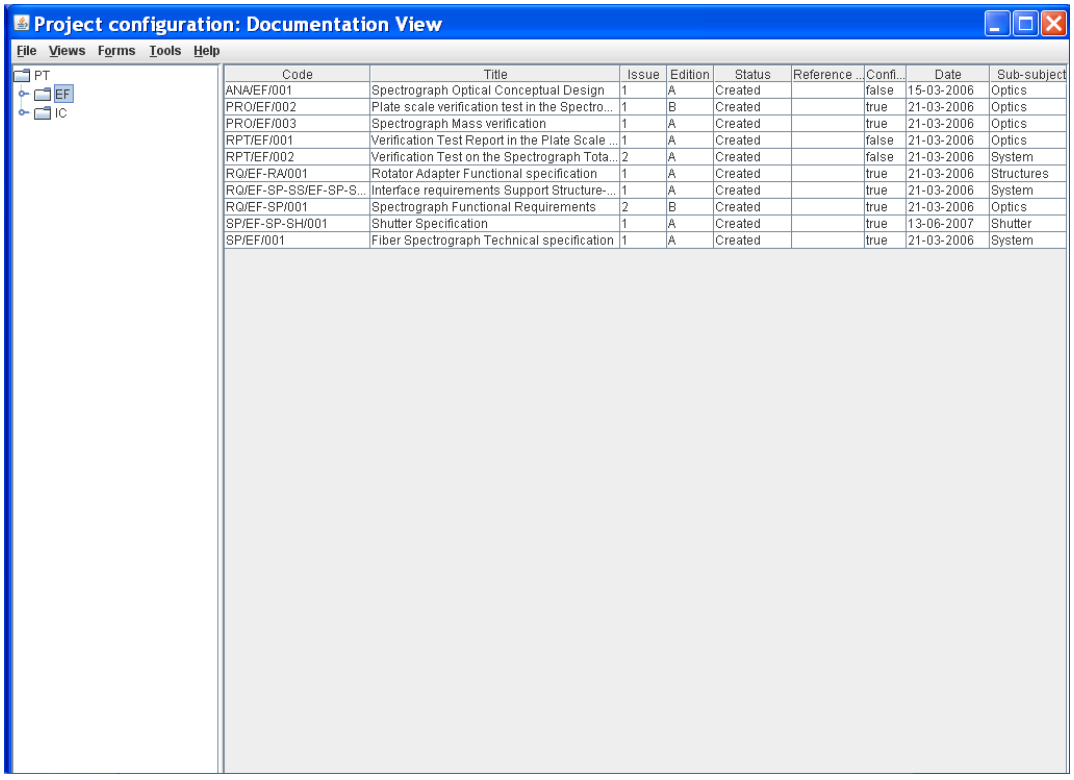


Figure 102: *Main window of the application*

The following steps must be executed in order to create a new Configuration Change:

A. Open the Configuration Changes Form.

In the Main window, the Configuration Changes Form can be opened in two different ways:

A.I. Going through the Forms Menu.

In the Main window, select *Forms Menu* ⇒ *Configuration Changes Form* or press *ALT+O+C*.

The Configuration Changes Form will be opened with all available records selected.

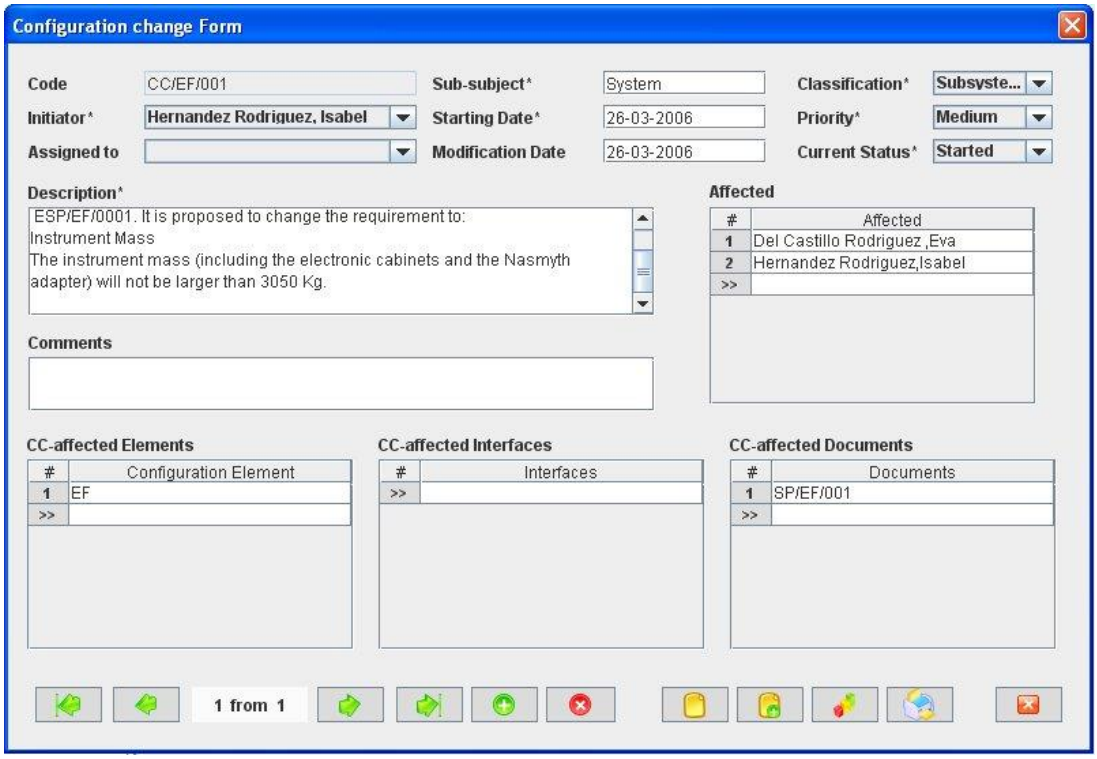


Figure 103: *Configuration Changes Form showing all the selected records*

A.II. Selecting a Configuration Change in the Configuration Changes View.

In the Main window, click the *Views Menu* ⇒ *Configuration Changes View* or press *ALT+V+C*.

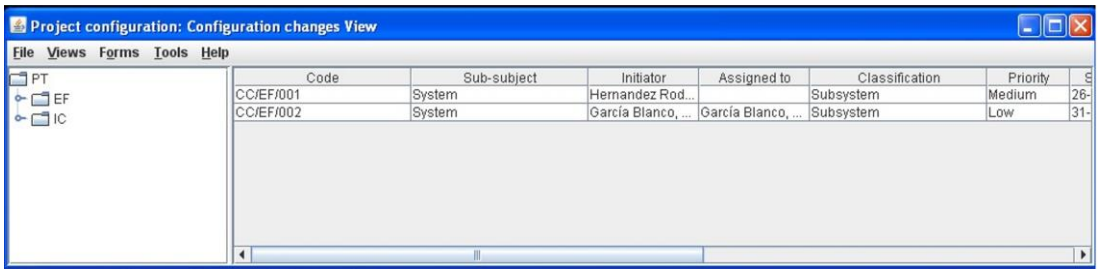


Figure 104: *Configuration Changes View (right panel) showing all the selected Configuration Changes associated to the selected PT element (left panel)*

Select a Configuration Change among the Configuration Changes listed in the table at the right side of the window by double-clicking with the left button of the mouse.

The Configuration Changes Form will be opened with the selected record available only.

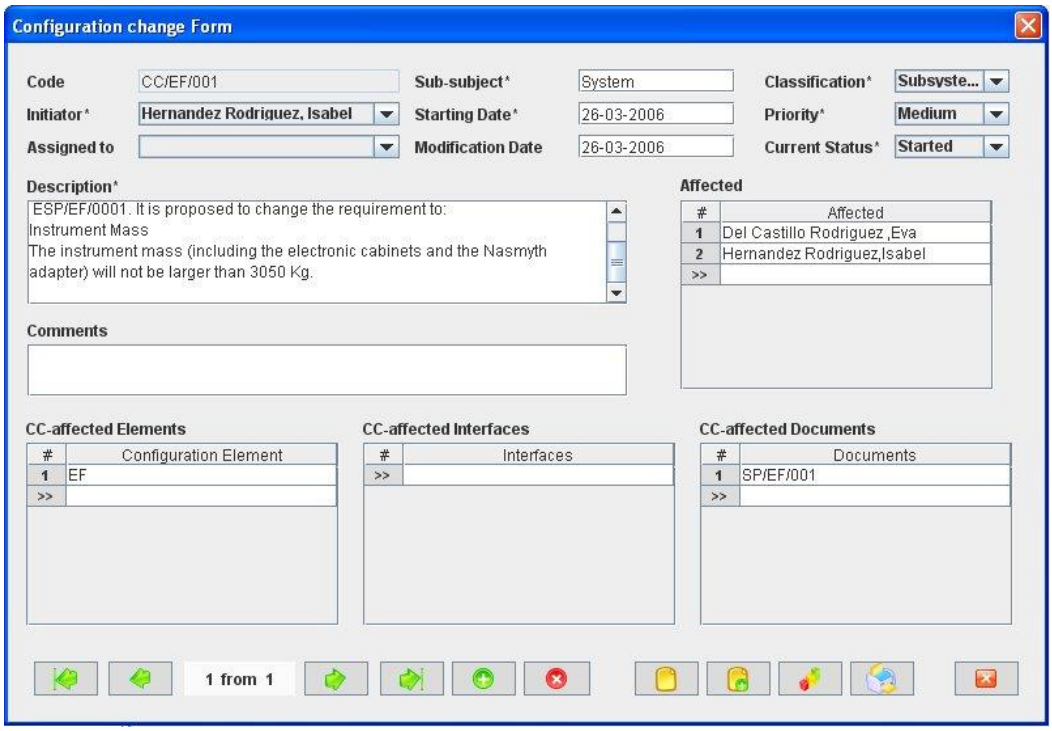


Figure 105: *Configuration Changes Form showing only the selected record*

B. Add a new record.

In the Configuration Changes Form, new Configuration Changes can be created in two different ways:

B.I. Starting an empty Configuration Change.

In the Configuration Changes Form, click the *Add* button to add a new record,

A new window will appear,

⇒ select the System PT element code in the *System* combo box (only the PT elements at system level are accessible),

⇒ click *Accept*,

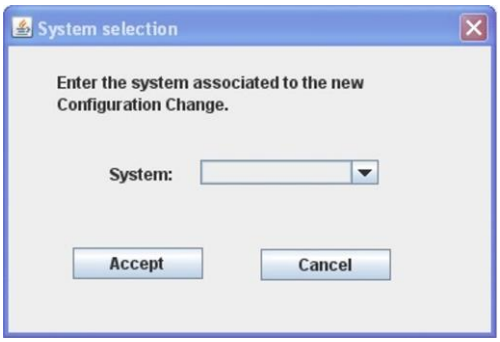


Figure 106: *Configuration Changes Form*

The new Configuration Change **Code** will be automatically generated as the first one available for the Configuration Change Product Tree element code selected.

All Configuration Changes Codes follow the same pattern as described below:

CC/PT/nnn

where,

CC: Configuration Change (these characters are always the same for all Configuration Changes)

PT: Product Tree Element code

nnn: Sequence number that will be automatically generated by the application

The Configuration Change Code is unique for each Configuration Change.

The Requirement code convention is defined before starting to use GECO. More information about it can be found in section 18.

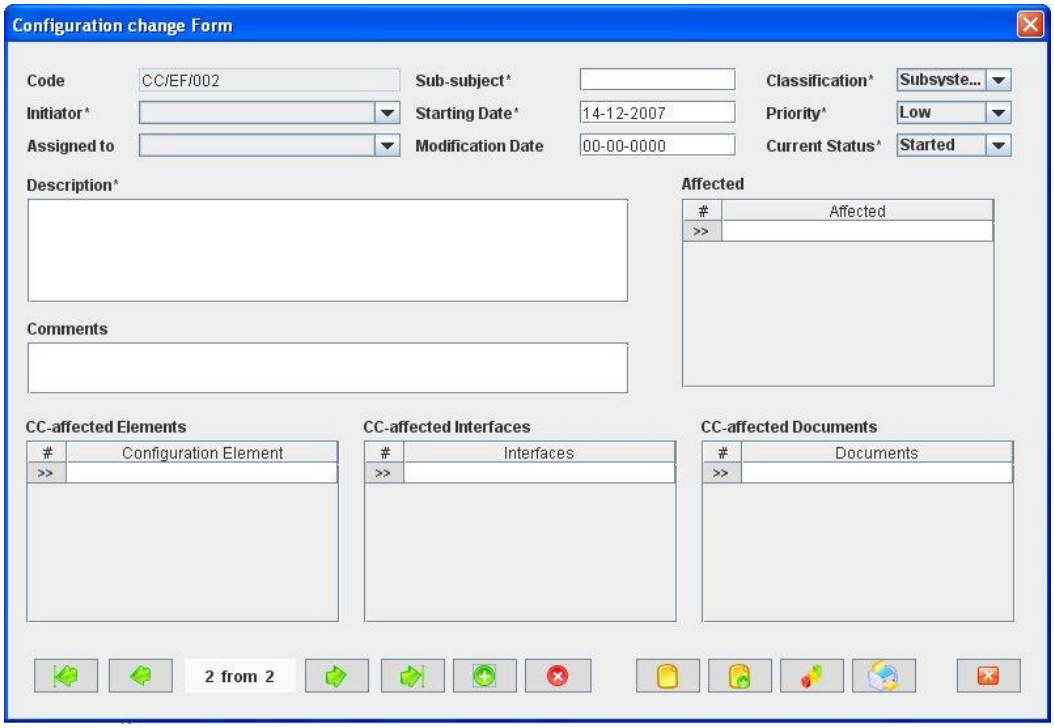


Figure 107: *Configuration Changes Form once the PT System has been chosen as shown in Figure 106*

B.II. Cloning an already existing Configuration Change.

In the Configuration Changes Form, click the *Copy button* to clone the Configuration Change that is currently selected in the form,

The new Configuration Change **Code** will be automatically generated as the first one available for the same Configuration Change Product Tree element code of the Configuration Change that has been cloned.

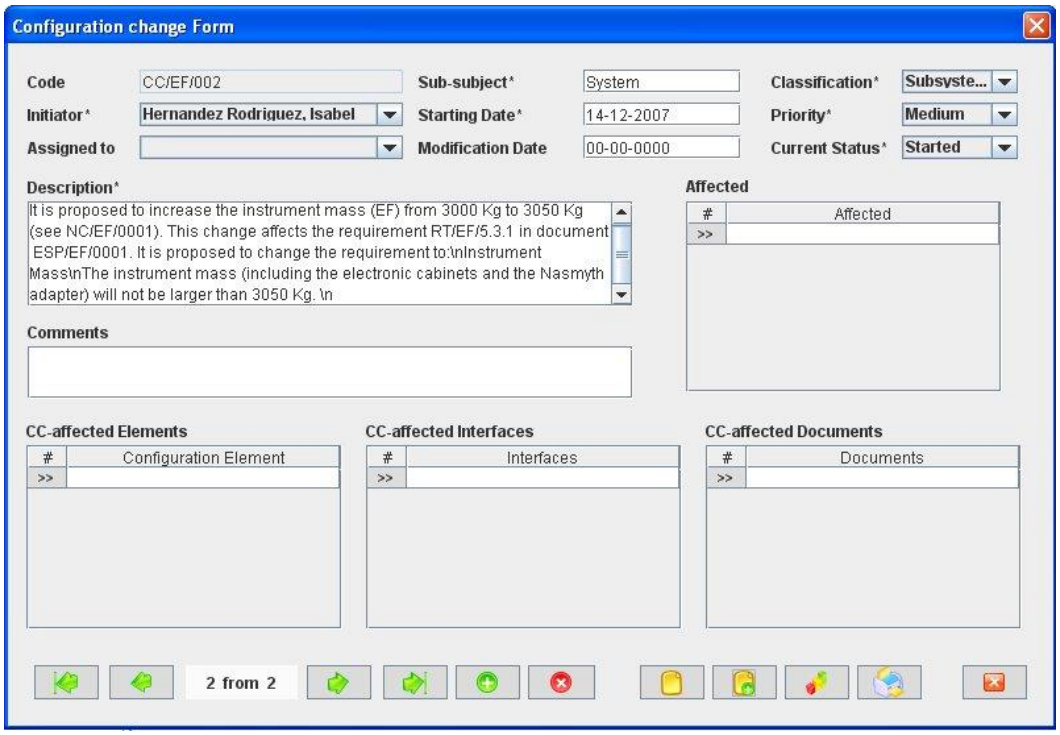


Figure 108: *Configuration Changes Form ready to introduce a new Configuration change by cloning an existing record*

C. Fill in the new record.

In the Configuration Changes Form, the mandatory fields that must be filled in are the following ones:

- **Code.** The Configuration Change code is automatically generated by the application and cannot be modified.
- **Sub-subject.** Indicate which subsystem (or group inside the organization) is affected by the Configuration Change. This is a text field with a maximum length of 20 characters.
- **Classification combo box.** Select the Configuration change type among the options offered in the Classification combo box, which includes the following ones:
  - *System* (the Configuration change affects to more than one particular subsystem)
  - *Subsystem* (the Configuration change affects to one subsystem only)

  By default, the classification is *"Subsystem"*.
- **Initiator.** Identify the person that is creating the Configuration Change. All persons in the organization that have been previously introduced as Users in the application (see section 15) can be selected from the combo box.
- **Starting date.** Indicate the date when the Configuration Change is being created. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.

- **Priority combo box.** Select the Configuration change priority among the options offered in the Priority combo box, which includes the following ones:
  - *High*
  - *Medium*
  - *Low*

  By default, the classification is *"Low"*.
- **Current status combo box.** Select the Configuration Change status among the options offered in the Status combo box, that includes the following ones:
  - *Started*
  - *Approved*
  - *Rejected*
  - *Suspended*
  - *Closed*
  - *Withdrawn*

  When the Configuration Change is created, the default status is *"Started"*.
- **Description.** Describe the change that must be done in the system. This is a text field and it does not have a maximum length limit.

The rest of the fields that can be optionally filled are:

- **Comments.** Introduce any additional comment related to the Configuration Change. This is a text field with a maximum length of 300 characters.
- **Affected.** Identify the persons that can be affected by the Configuration Change (as many persons as desired can be selected). The affected persons will receive a notification email related to the Configuration Change modifications. All persons in the organization that have been previously introduced as Users in the application (see section 15) can be selected from the combo box.
- **CC-affected elements.** Identify the PT elements that are affected by the Configuration Change (as many elements as wanted can be selected). In the combo box, all PT elements existing in the application can be selected.
- **CC-affected interfaces.** Identify the Interfaces that are affected by the Configuration Change (as many Interfaces as wanted can be selected). In the combo box, all Interfaces existing in the application can be selected.
- **CC-affected documents.** Identify the Documents that are affected by the Configuration Change (as many Documents as wanted can be selected). In the combo box, all Documents existing in the application can be selected.

The fields *Assigned to* and *Modification date* should not be filled at the creation of the Configuration Change. These fields must be filled at the CRB where the Configuration Change is reviewed.

D. Save the new record.

In the Configuration Changes Form, click the *Save* button to save the record,

If the current record is not saved, the new record will not be created.

Once the Configuration Change is saved, the application will send an email to notify that the Configuration Change has been created.

> "*The current status of the Configuration Change* (Code) *is* (new status)" to be sent to the Initiator, the person assigned to do it (if exits) and the affected persons (if exits).

E. Close the Configuration Changes Form

In the Configuration Changes Form, click the *Exit* button to exit the form,

If the record has been saved, the Configuration Changes Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 109: *Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving

⇒ Click *NO* to come back to the Configuration Changes Form.

11.3 Selecting a particular Configuration Change

In the Main window, the form view of a particular Configuration Change can be opened in two different ways:

A. Going through the Forms Menu.

In the Main window, select *Forms* Menu ⇒ *Configuration Changes* Form or press *ALT+O+C*.

In order to find a particular Configuration Change, the following actions can be done:

⇒ Use the arrows for moving among the Configuration Changes currently selected in the form,

To go to the first record of the selected ones,

To go to the previous record to the current one,

To go to the next record to the current one and

To go to the last record of the selected ones

⇒ Use the *Filter* button to filter/un-filter the set of Configuration Changes currently selected in the form,

A new window will appear:

⇒ Click *Data filter activated* box to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be recorded),

⇒ select in the *Field* combo box the desired field to filter the data,

⇒ select in the *Op* combo box how the previously selected field must match the defined *Value* (i.e., "*starting with*", "*contains*", *"is"*, "*ending by*")

⇒ write in the *Value Text* Field the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

⇒ define as many filters as wanted (by adding new lines),

⇒ click *Accept*,

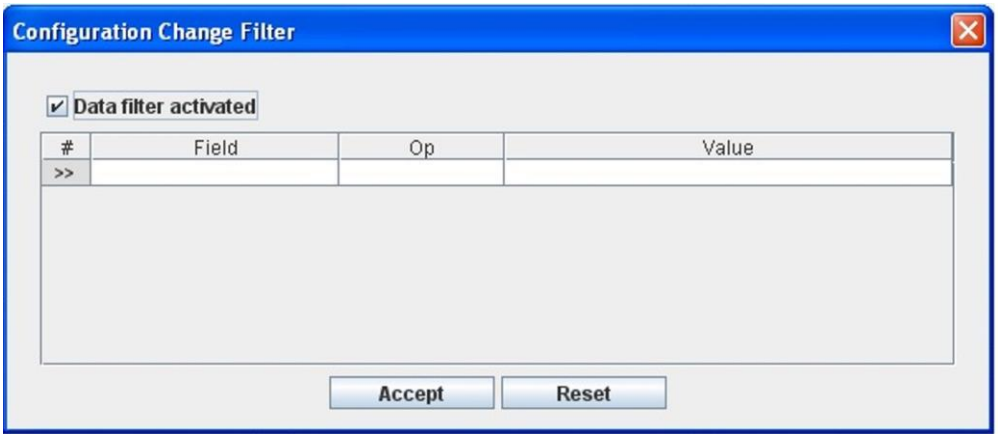


Figure 110: *Configuration Change Filter to select the desired documents by different fields*

B. Selecting the Configuration Change in the Configuration Changes View.

In the Main window, click the *Views* Menu ⇒ *Configuration Changes* View or press *ALT+V+C*.

In order to constrain (by Product Tree Element or by filtering) the number of Configuration Changes listed in the view, see the steps to be followed in section 4.2.

Select the desired Configuration Change among the Configuration Changes listed in the table at the right side of the window by double-clicking with the left button of the mouse.

11.4 Modifying existing Configuration Changes

The Configuration Change to be modified must be already selected, which will be done by following the steps described in section 11.3.

In the Configurations Change Form, the following steps must be done in order to modify the selected Configuration Change.

A. Modify the desired fields.

Make the desired changes in the Configurations Change fields, taking into account the constrains identified in section 11.2, numbered item C) and, also, that the *Code*, *Initiator* and *Starting date* fields cannot been modified once the Configuration Change has been already created.

All the rest of the fields can be modified and, in particular, the following fields must be filled after the CRB meeting where the Configuration Change is presented:

- **Assigned to.** Identify the person that is going to do the Configuration Change actions. All persons in the organization that have been previously introduced as Users in the application (see section 15) can be selected from the combo box.
- **Modification date.** Indicate the date when the Configuration Change is being modified. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.

B. Save the modified record.

In the Configuration Changes Form, click the *Save* button to save the record,

If the record is not saved, the changes will not be applied.

Once the Configuration Change is saved, the application will send an email to notify that a modification has been done to the Configuration Change. This notification could be the following ones depending of the modification done

> "*The current status of the Configuration Change* (Code) *is* (new status)" to be sent to the Initiator, the person assigned to do it and the affected persons whenever the status is changed.

"*The Assigned person to the Configuration Change* (Code) *has been changed*" to be sent to the initiator, to the previous people assigned and to the new one.

C. Close the Configuration Changes Form

In the Configurations Changes Form, click the *Exit button* to exit the form,

If the record has been saved, the Configuration Changes Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 111: *Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving.

⇒ Click *NO* to come back to the Configuration Changes Form.

11.5 Printing a Configuration Change

The Configuration Change to be printed must be already selected, which will be done by following the steps described in section 11.3.

In the Configurations Change Form, the following step must be done in order to print the selected Configuration Change.

A. Print the record.

In the Configuration Changes Form, click the *Print button* to print the record,

A preview of the record to be printed will appear.

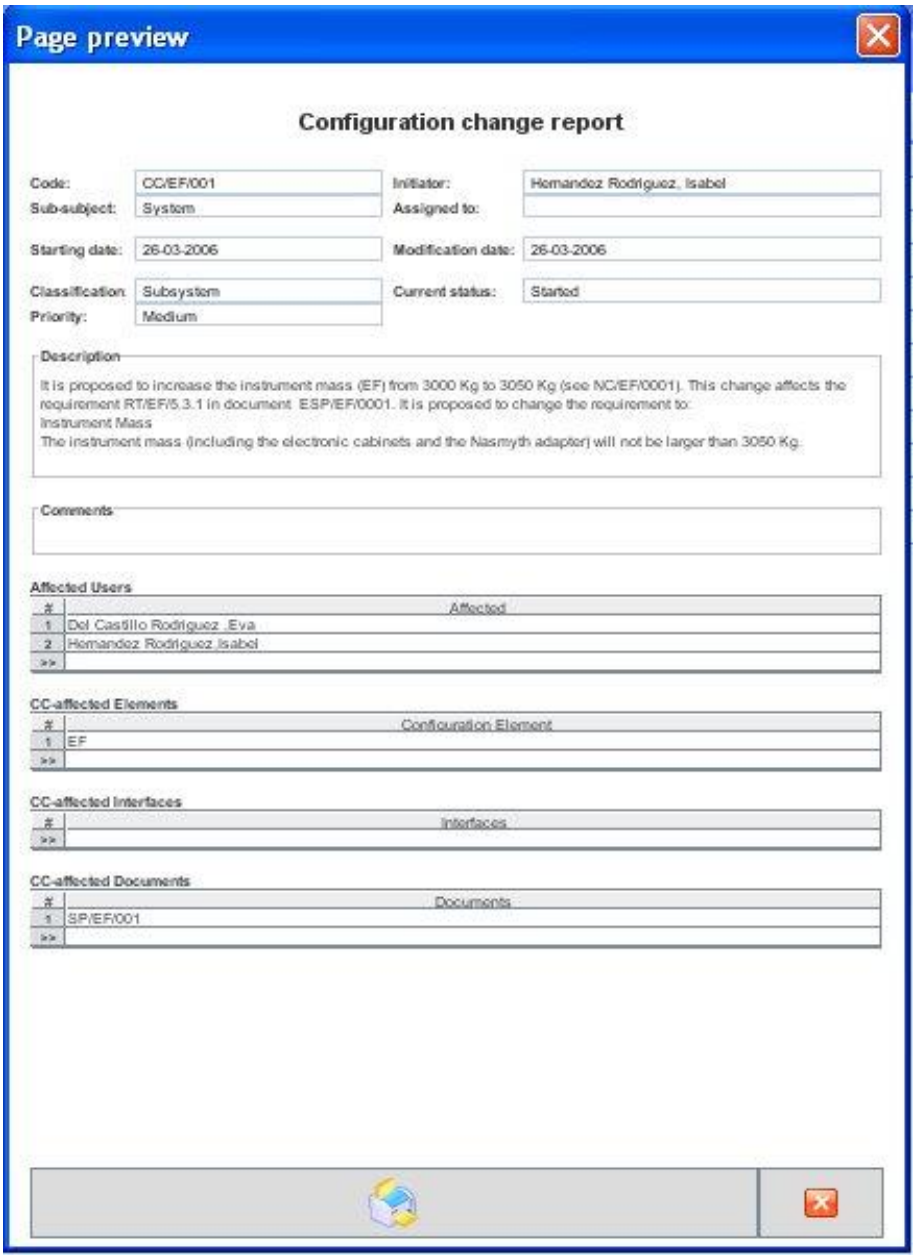


Figure 112: *Preview window for the Configuration change to be printed.*

⇒ Select the *Print button* to print the record,

or,

⇒ Select *Cancel button* to come back to the Configuration Change form without printing.

If the *Print button* is selected, the application will look for the printers connected to your computer and the print menu will be opened.

A new window will appear,

⇒ select in the *Name combo box* the printer to be used,

⇒ define the desired properties for this job,

⇒ click *Accept*,

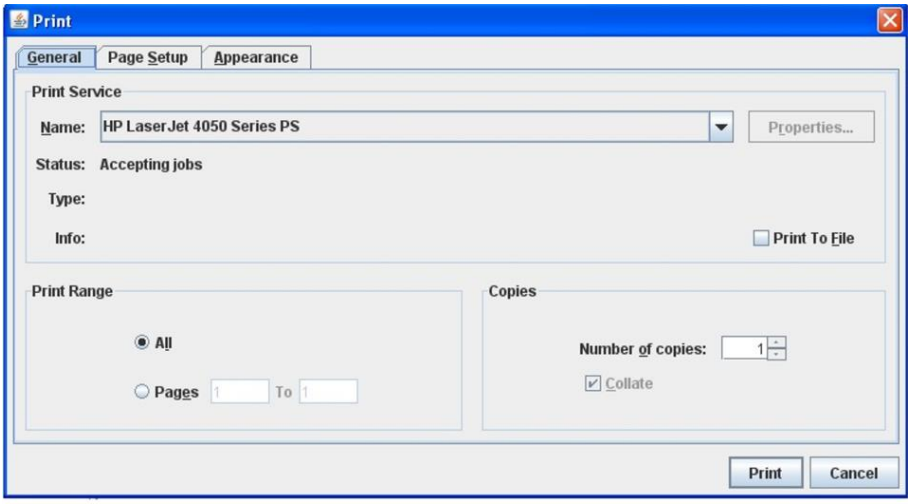


Figure 113: *Print Dialog. The selected record will be printed*

11.6 Deleting a Configuration Change

The Configuration Change to be deleted must be already selected, which will be done by following the steps described in section 11.3.

In the Configuration Changes Form, the following steps must be done in order to delete the selected Configuration Change.

A. Delete the record.

In the Configuration Changes Form, click the *Delete button* to delete the record,

A new window will appear to ask the user if he/she really wants to delete the record.

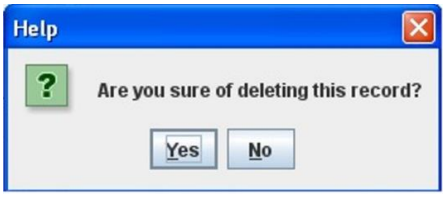


Figure 114: *Warning Window to check if the user wants to delete the record*

⇒ Click *YES* to delete the record.

⇒ Click *NO* to exit without deleting.

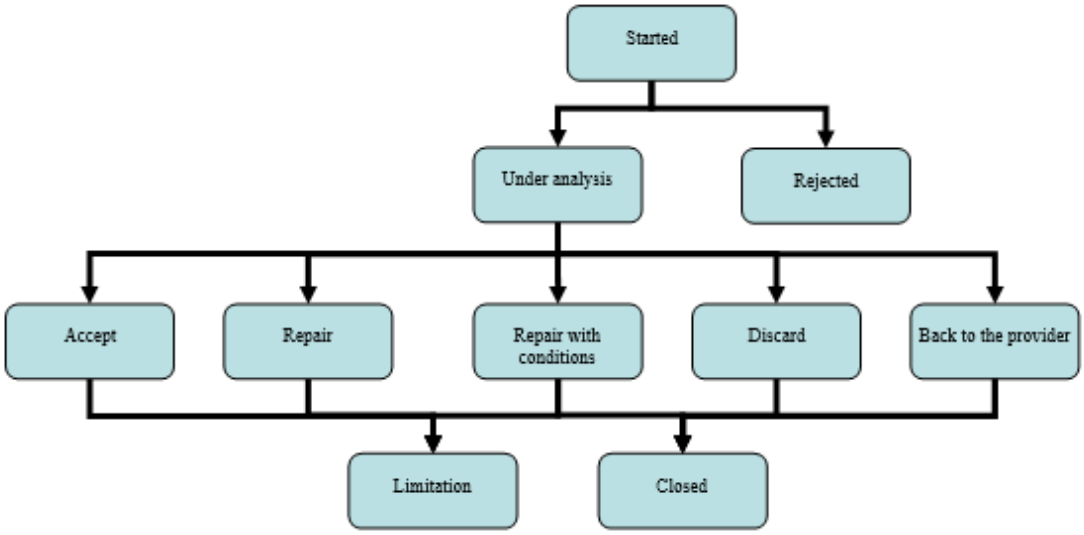
12. NON-CONFORMITIES

12.1 What is a Non-conformity?

A Non-conformity is defined as the non-fulfilment of a specified requirement.

A Non-conformity is normally raised by the Contractor (or the group that is developing a system) of system after realizing that they cannot achieve a particular requirement

The Non-conformities follow a life-cycle as shown in the figure:



This life-cycle can be briefly summarized in the following steps:

- In the first place, the Non-conformity request must be introduced in the application. It is important that all relevant information related to this particular Non-conformity is identified to allow the NRB (Non-conformity Review Board) evaluate the Non-conformity implication. At that point, the Non-conformity status is *"Started"*.

- At the NRB meeting, the Non-conformity is analyzed and the Non-conformity state can be changed to *"Under analysis"* or *"Rejected"* depending of the board decision. If the Non-conformity is classified as *"Under Analysis"* then the people in charge (*Assigned to*) to analyze it in more detail, shall be appointed.

- After the necessary analysis is performed, the Non-conformity responsible can request to change the state of the Non-conformity to *"Accept"* (i.e., the item is found to be useful as it is), *"Repair"* (i.e., the item must be repaired to fulfil the requirements), *"Repair with conditions"* (i.e., the item must be repaired although a change in the scope of the requirements is accepted), *"Discard"* (i.e., the item is not usable as it is) or *"Back to the provider"* (i.e., the item cannot be accepted and it is returned to the provider, who must provide another one).

- Finally, the NRB must take into account the analysis made by the responsible in order to decide if the Non-conformity is ending as *"Closed"*, as *"Limitation"* (i.e., the Non-conformity is not going to be solved and it must be accepted as a Limitation of the system) or as *"Obsolete"*. One of the actions that could be performed during the Non-

conformity life is to raise a Configuration Change to request a modification of the requirements according to the Non-conformity analysis.

GECO provides the support to manage and archive the Non-conformities. In this sense, all the relevant information generated during the Non-conformity life-cycle can be introduced and maintained in the application. GECO will also help in the Non-conformity coordination and information distribution by sending emails at the most important Non-conformity life-cycle transitions.

12.2 Creating a Non-conformity

Starting at the Main Window of the application,

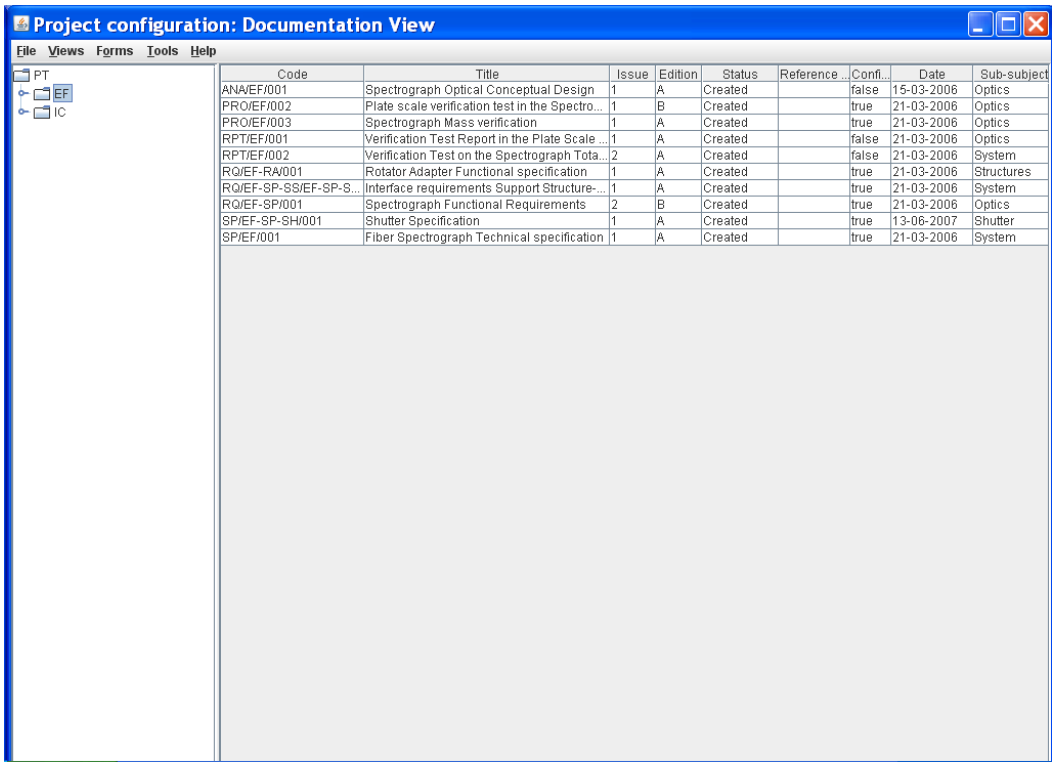


Figure 115: *Main window of the application*

the following steps must be executed in order to create a new Non-conformity:

A. Open the Non-conformities Form.

In the Main window, the Non-conformities Form can be opened in two different ways:

A.I. Going through the Forms Menu.

In the Main window, select *Forms Menu* ⇒ *Non-conformities Form* or press *ALT+O+N*.

The Non-conformities Form will be opened with all available records selected.

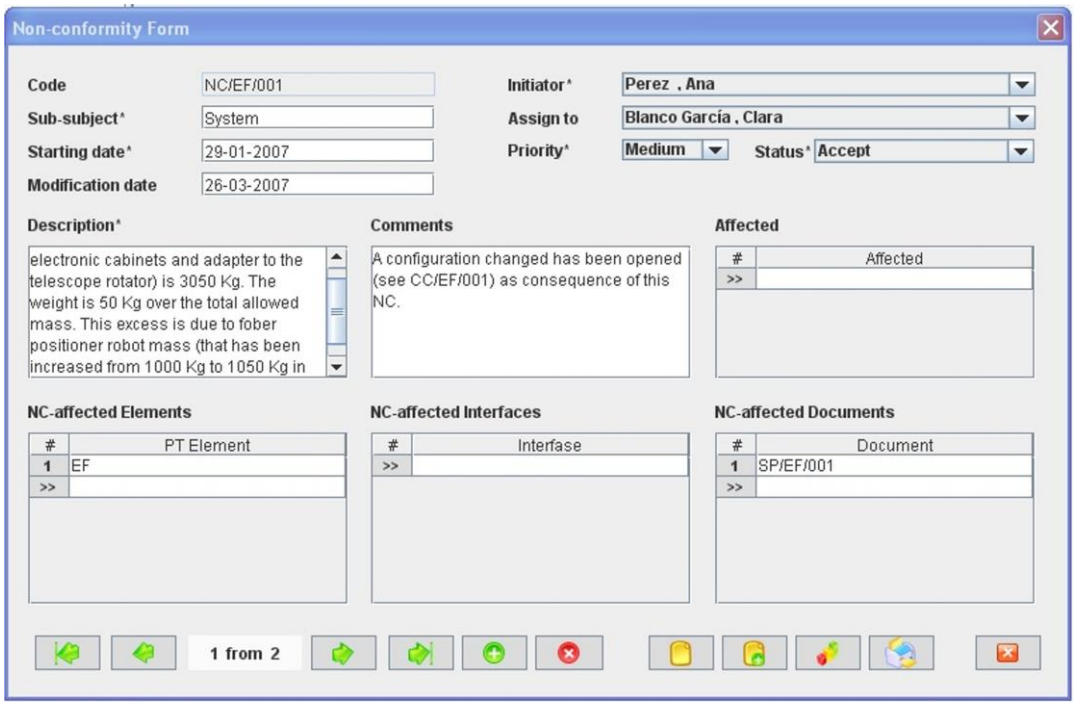


Figure 116: *Non-conformities Form showing all the selected records*

A.II. Selecting a Non-conformity in the Non-conformities View.

In the Main window, click the *Views* Menu ⇒ *Non-conformities* View or press *ALT+V+N*

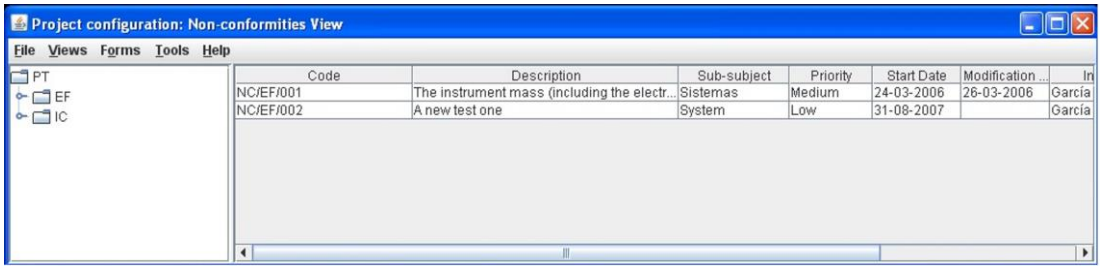


Figure 117: *Non-conformities View (right panel) showing all the selected Non-conformities associated to the selected PT element (left panel)*

Select a Non-conformity among the Non-conformities listed in the table at the right side of the window by double-clicking with the left button of the mouse.

The Non-conformities Form will be opened with the selected record available only.

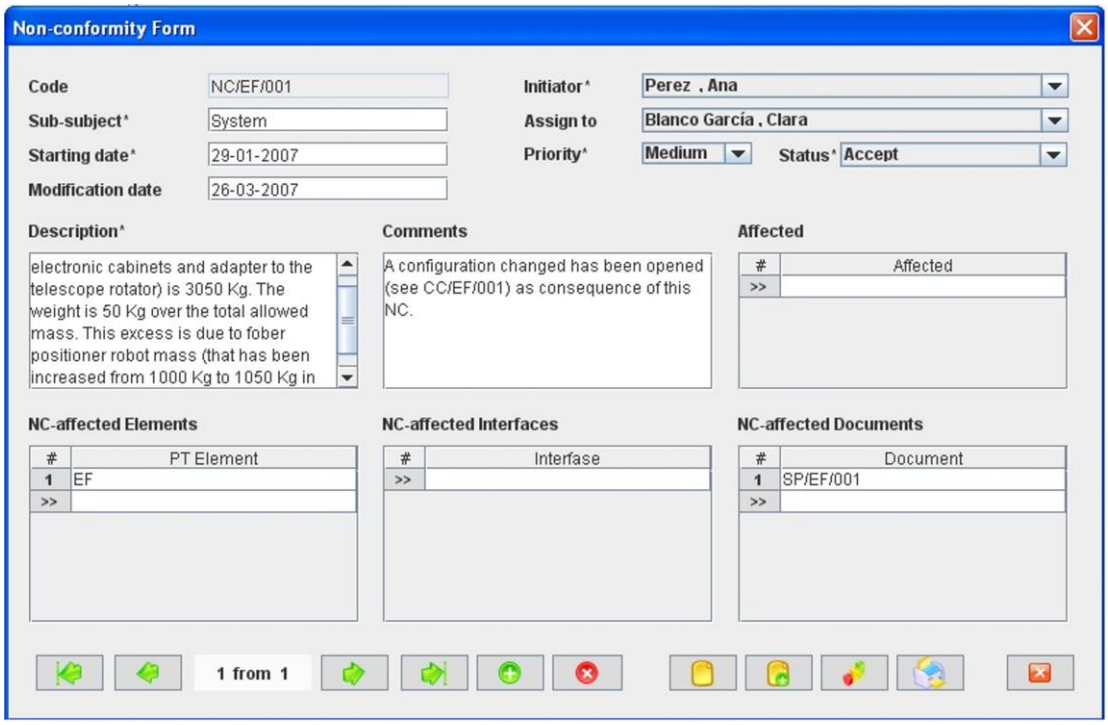


Figure 118: *Non-conformity Form showing only the selected record*

B. Add a new record.

In the Non-conformities Form, new Non-conformities can be created in two different ways:

B.I. Starting an empty Non-conformity.

In the Non-conformities Form, click the *Add* button to add a new record,

A new window will appear,

⇒ select the System PT element code in the *System* combo box (only the PT elements at system level can be selected),

⇒ click *Accept*,

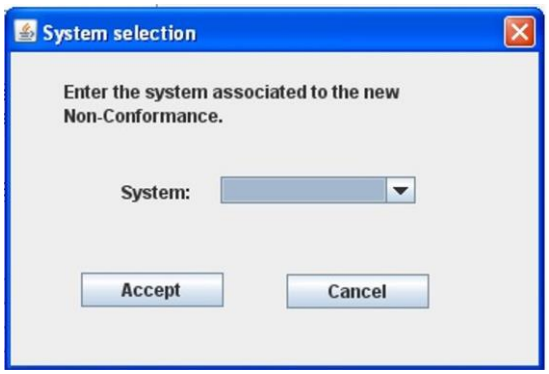


Figure 119: *Non-conformities Form*

The new Non-conformity **Code** will be automatically generated as the first one available for the Non-conformity Product Tree element code selected.

All Non-conformities Codes follow the same pattern as described below:

NC/PT/nnn

where,

NC: Non-conformity (these characters are always the same for all Non-conformities)

PT: Product Tree Element code

nnn: Sequence number that will be automatically generated by the application

The Non-conformity Code is unique for each Non-conformity.

The Requirement code convention is defined before starting to use GECO. More information about it can be found in section 18.

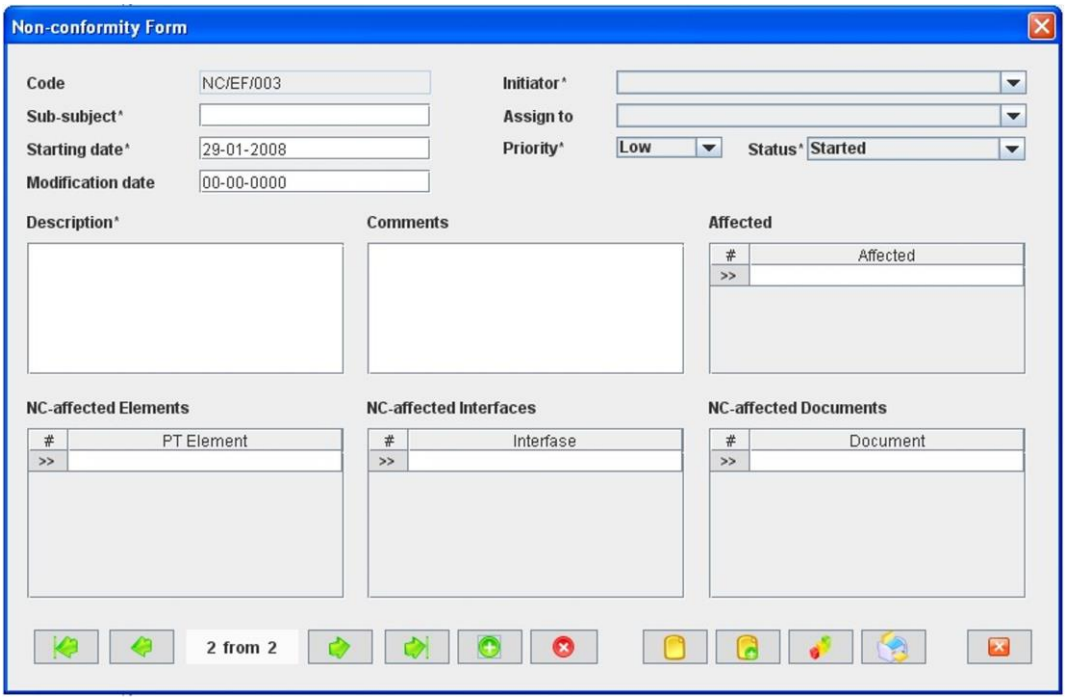


Figure 120: *Non-conformities Form once the PT System has been chosen as shown in Figure 119*

B.II. Cloning an already existing Non-conformity.

In the Non-conformity Form, click the *Copy button* to clone the Non-conformity that is currently selected in the form,

The new Non-conformity **Code** will be automatically generated as the first one available for the same Non-conformity Product Tree element code of the Non-conformity that has been cloned.

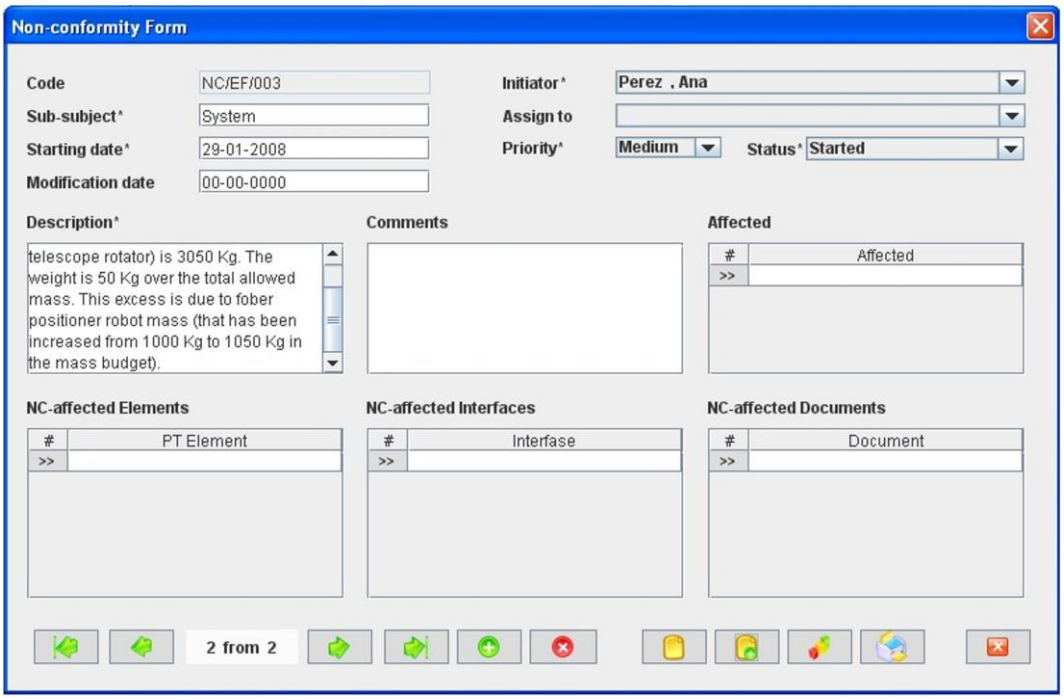


Figure 121: *Non-conformities Form ready to introduce a new Non-conformity by cloning an existing record*

C. Fill in the new record.

In the Non-conformity Form, the mandatory fields that must be filled in are:

- **Code.** The Non-conformity code is automatically generated by the application and cannot be modified.
- **Sub-subject.** Indicate what subsystem (or group inside the organization) is affected by the Non-conformity. This is a text field with a maximum length of 20 characters.
- **Initiator.** Identify the person that is creating the Non-conformity. All persons in the organization that have been previously introduced as Users in the application (see section 15) can be selected from the combo box.
- **Starting date.** Indicate the date when the Non-conformity is being created. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.
- **Priority combo box.** Select the Non-conformity priority among the options offered in the Priority combo box, that includes the following ones:
  - *High*
  - *Medium*
  - *Low*

  By default, the classification is *"Low"*.
- **Status combo box.** Select the Non-conformity status among the options offered in the Status combo box, that includes:

- *Started*
- *Under analysis*
- *Rejected*
- *Accept*
- *Repair*
- *Repair with conditions*
- *Discard*
- *Back to the provider*
- *Closed*
- *Limitation*

When the Non-conformity is created, the default status is *"Started"*.

- **Description.** Describe the Non-conformity in detail, identifying the requirements that are not met and the consequences of the Non-conformity in meeting the objectives of the system. This is a text field and it does not have a maximum length limit.

The rest of the fields that can be optionally filled are:

- **Comments.** Introduce any additional comment related to the Non-conformity. This is a text field and it does not have a maximum length limit.
- **Affected.** Identify the persons that can be affected by the Non-conformity (you can select as many persons as required). The affected persons will receive a notification email related to the Non-conformity modifications. All persons in the organization that have been previously introduced as Users in the application (see section 15) can be selected from the combo box.
- **NC-affected Elements.** Identify the PT elements that are affected by the Non-conformity (you can select as many elements as required). In the combo box, all PT elements existing in the application can be selected.
- **NC-affected Interfaces.** Identify the Interfaces that are affected by the Non-conformity (you can select as many interfaces as required). In the combo box, all Interfaces existing in the application can be selected.
- **NC-affected Documents.** Identify the Documents that are affected by the Non-conformity (you can select as many documents as required). In the combo box, all Documents existing in the application can be selected.

The fields *Assigned to* and *Modification date* should not be filled at the creation of the Non-conformity. These fields must be filled at the NRB where the Non-conformity is reviewed.

D. Save the new record.

In the Non-conformities Form, click the *Save* button to save the record,

If the current record is not saved, the new record will not be created.

Once the Non-conformity is saved, the application will send an email to notify that the Non-conformity has been created.

> "*The current status of the Non-conformity* (Code) *is* (new status)" to be sent to the Initiator, the person assigned to do it (if exits) and the affected persons (if exits).

E. Close the Non-conformities Form

In the Non-conformities Form, click the *Exit* button to exit the form,

If the record has been saved, the Non-conformities Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 122: *Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving

⇒ Click *NO* to come back to the Non-conformities Form.

12.3 Selecting a particular Non-conformity

In the Main window, the form view of a particular Non-conformity can be opened in two different ways:

A. Going through the Forms Menu.

In the Main window, select *Forms* Menu ⇒ *Non-conformities* Form or press *ALT+O+N*.

In order to find a particular Non-conformity, the following actions can be done:

⇒ Use the arrows for moving among the Non-conformities currently selected in the form,

To go to the first record of the selected ones,

To go to the previous record to the current one,

To go to the next record to the current one and

To go to the last record of the selected ones

⇒ Use the *Filter* button to filter/un-filter the set of Non-conformities currently selected in the form,

A new window will appear:

⇒ Click *Data filter activated* box to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be recorded),

⇒ select in the *Field* combo box the desired field to filter the data,

⇒ select in the *Op* combo box how the previously selected field must match the defined *Value* (i.e., "*starting with*", "*contains*", *"is",* "*ending by*")

⇒ write in the *Value Text* field the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

⇒ define as many filters as wanted (by adding new lines),

⇒ click *Accept*,

Figure 123: *Non-conformities Filter to select the desired documents by different fields*

B. Selecting the Non-conformity in the Non-conformities View.

In the Main window, click the *Views* Menu ⇒ *Non-conformities* View or press *ALT+V+N*.

In order to constrain (by Product Tree Element or by filtering) the number of Non-conformities listed in the view, see the steps to be followed in section 4.2.

Select the desired Non-conformity among the Non-conformities listed in the table at the right side of the window by double-clicking with the left button of the mouse.

12.4 Modifying existing Non-conformities

The Non-conformity to be modified must be already selected, which will be done by following the steps described in section 12.3.

In the Non-conformities Form, the following steps must be done in order to modify the selected Non-conformity.

A. Modify the desired fields.

Make the desired changes in the Non-conformity fields, taking into account the constrains identified in section 12.2, numbered item C) and, also, that the *Code*, *Initiator* and *Starting date* fields cannot been modified once the Non-conformity has been already created.

All the rest of the fields can be modified and, in particular, the following fields must be filled after the NRB meeting where the Non-conformity is presented:

- **Assigned to.** Identify the person that is going to do the Non-conformity evaluation. All persons in the organization that have been previously introduced as Users in the application (see section 15) can be selected from the combo box.
- **Modification date.** Indicate the date when the Non-conformity is being modified. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.

B. Save the modified record.

In the Non-conformities Form, click the *Save* button to save the record,

If the record is not saved, the changes will not be applied.

Once the Non-conformity is saved, the application will send an email to notify that a modification has been done to the Non-conformity. This notification could be the following ones depending of the modification done

> "*The current status of the Non-conformity* (Code) *is* (new status)" to be sent to the Initiator, the person assigned to do it and the affected persons whenever the status is changed.
>
> "*The Assigned person to the Non-conformity* (Code) *has been changed*" to be sent to the Initiator, to the previous responsible and to the new one.

C. Close the Non-conformities Form

In the Non-conformities Form, click the *Exit* button to exit the form,

If the record has been saved, the Non-conformities Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 124: *Warning Window reporting that changes have not been saved*

⇒ Click *YES* to exit without saving.

⇒ Click *NO* to come back to the Non-conformities Form.

12.5 Printing a Non-conformity

The Non-conformity to be printed must be already selected, which will be done by following the steps described in section 12.3.

In the Non-conformity Form, the following step must be done in order to print the selected Non-conformity.

B. Print the record.

In the Non-conformity Form, click the *Print button* to print the record,

A preview of the record to be printed will appear.

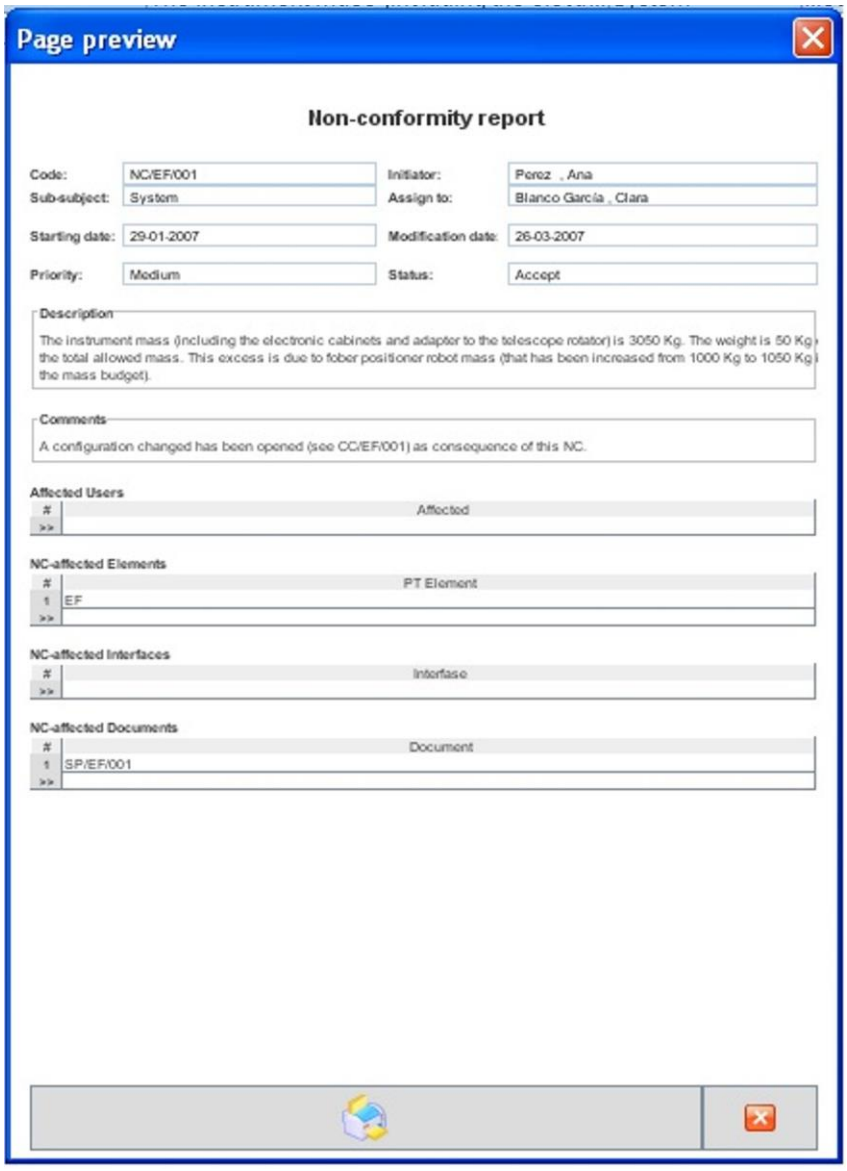


Figure 125: *Preview window for the Non-conformity to be printed.*

⇒ Select the *Print button* to print the record,

or,

⇒ Select *Cancel button* to come back to the Non-conformity form without printing.

If the *Print button* is selected, the application will look for the printers connected to your computer and the print menu will be opened.

A new window will appear,

⇒ select in the *Name combo box* the printer to be used,

⇒ define the desired properties for this job,

⇒ click *Accept*,

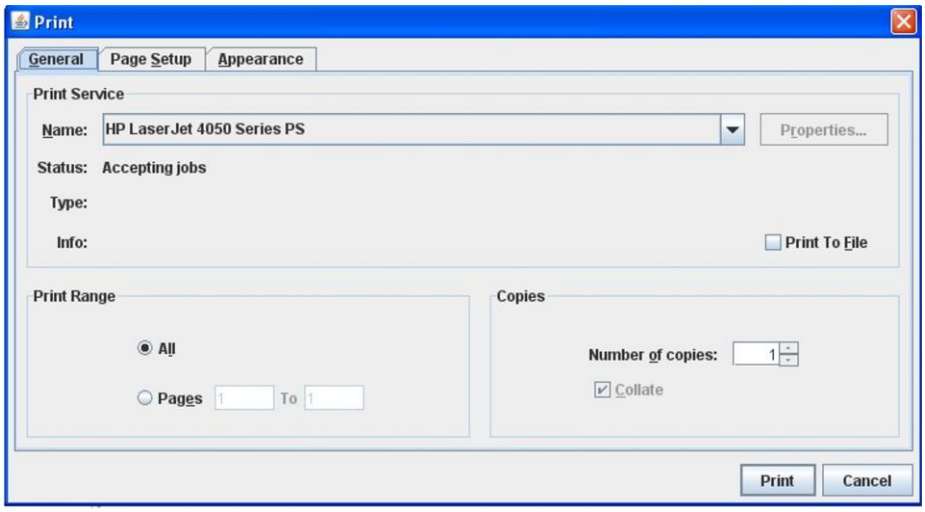


Figure 126: *Print Dialog. The selected record will be printed*

12.6 Deleting a Non-conformity

The Non-conformity to be deleted must be already selected, which will be done by following the steps described in section 12.3.

In the Non-conformities Form, the following steps must be done in order to delete the selected Non-conformity.

A. Delete the record.

In the Non-conformities Form, click the *Delete* button to delete the record,

A new window will appear to ask the user if he/she really wants to delete the record.

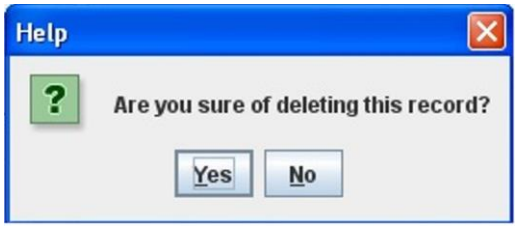


Figure 127: *Warning Window to check if the user wants to delete the record*

⇒ Click *YES* to delete the record.

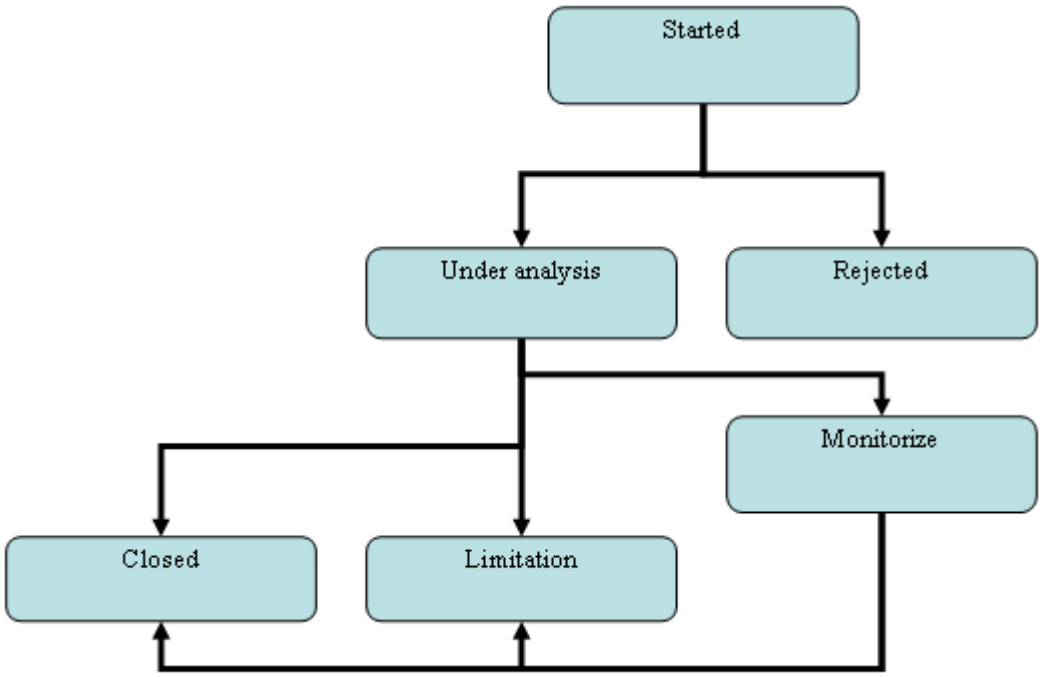
⇒ Click *NO* to exit without deleting.

13. ANOMALIES

13.1 What is an Anomaly?

An Anomaly is any abnormal behavior of the system that must be recorded and investigated.

The Anomalies follow a life-cycle as shown in the figure:



This life-cycle can be briefly summarized in the following steps:

- In the first place, all relevant information related to the Anomaly must be introduced in the application to allow the ARB (Anomaly Review Board) evaluate the Anomaly consequences. At that point, the Anomaly status is *"Started"*.
- At the ARB meeting, the Anomaly is evaluated and the Anomaly state can be changed to *"Under analysis"* or *"Rejected"* depending of the board decision. If the Anomaly is classified as *"Under Analysis"* then a responsible (*Assigned to*) must be appointed, in charge to analyze it in more detail.
- After the necessary analysis is performed, the Anomaly's responsible can request to change the state of the Anomaly to *"Monitorize"* (i.e., the Anomaly must be maintained opened to monitorize any reoccurrences during a certain period), *"Closed"* (i.e., the Anomaly has been solved or the analysis made by the responsible indicates that it is not going to reoccur) or *"Limitation"* (i.e., the Anomaly cannot be solved and must be accepted as a Limitation of the system).
- Finally, the ARB must take into account the analysis made by the Anomaly's responsible and has to decide if the Anomaly is ending as *"Closed"* or as a *"Limitation"*. One of the actions that could be performed during the Anomaly life is to

raise a Configuration Change to request a modification of the system in order to solve the Anomaly or to raise a Non-conformity if the Anomaly is a consequence of the System requirements not having been correctly fulfilled.

GECO provides the support to manage and archive the Anomalies. In this sense, all the relevant information generated during the Anomaly life-cycle can be introduced and maintained in the application. GECO will also help in the Anomaly coordination and information distribution by sending emails at the most important Anomaly life-cycle transitions.

13.2 Creating a new Anomaly

Starting at the Main Window of the application,

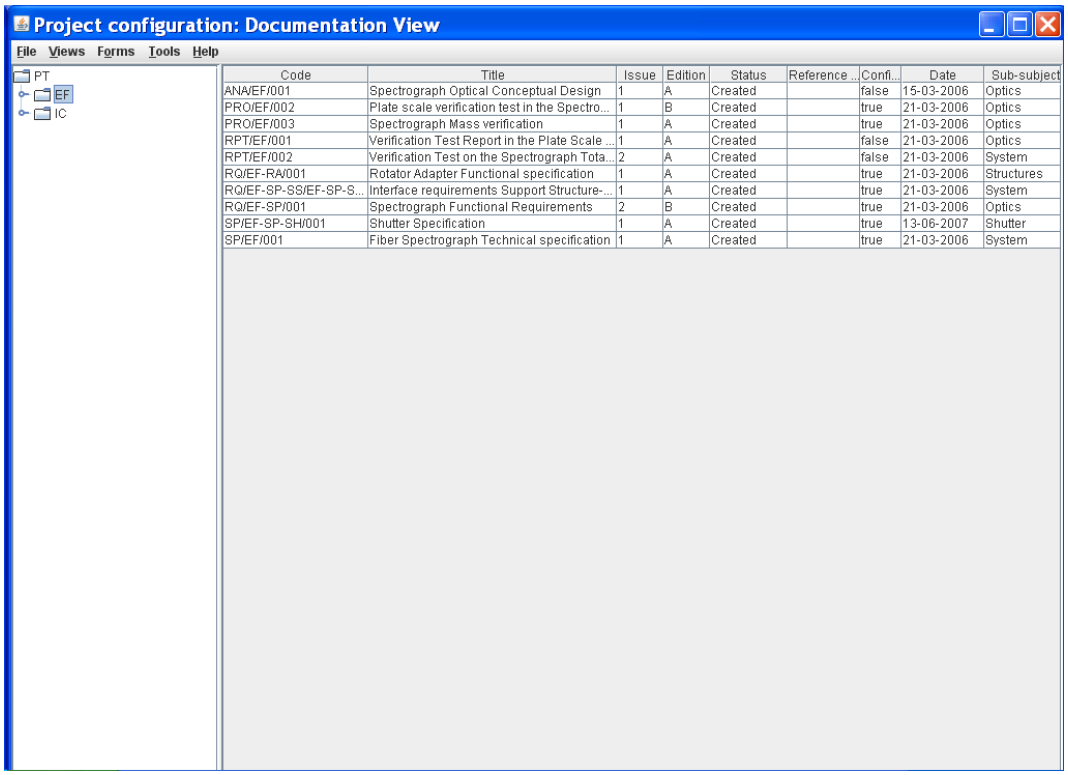


Figure 128: *Main window of the application*

The following steps must be executed in order to create a new Anomaly:

A. Open the Anomalies Form.

In the Main window, the Anomalies Form can be opened in two different ways:

A.I. Going through the Forms Menu.

In the Main window, select *Forms* Menu $\Rightarrow$ *Anomalies* Form or press *ALT+O+A*.

The Anomalies Form will be opened with all available records selected.

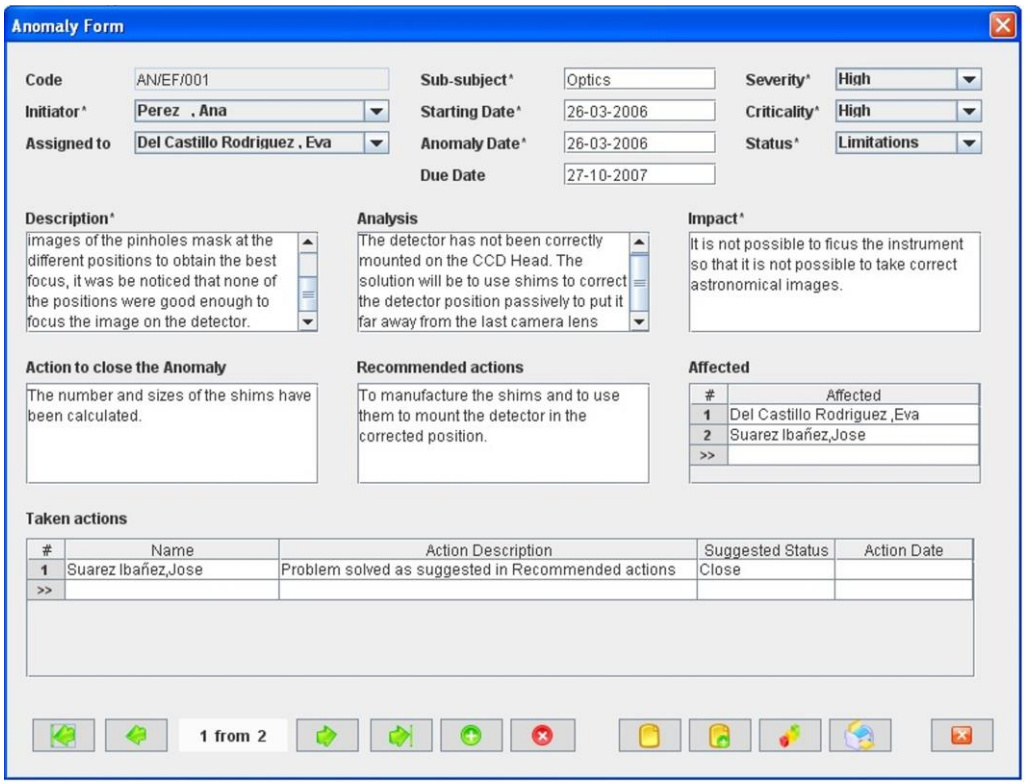


Figure 129: *Anomaly Form showing all the selected records*

A.II. Selecting an Anomaly in the Anomalies View.

In the Main window, click the *Views* Menu ⇒ *Anomalies* View or press *ALT+V+A*

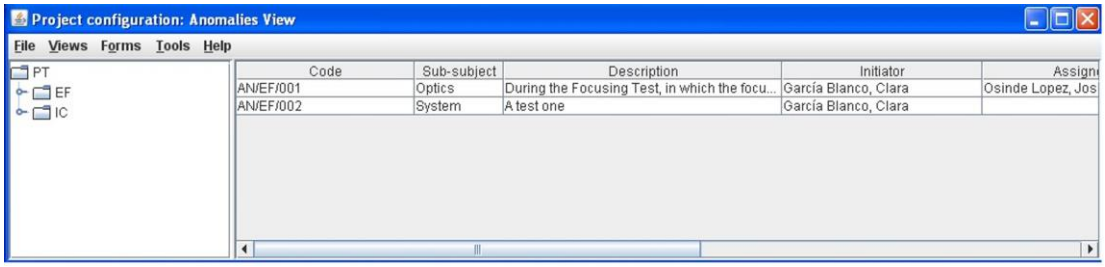


Figure 130: *Anomalies View (right panel) showing all the selected Anomalies associated to the selected PT element (left panel)*

Select an Anomaly among the Anomalies listed in the table at the right side of the window by double-clicking with the left button of the mouse.

The Anomalies Form will be opened only with the selected record available.

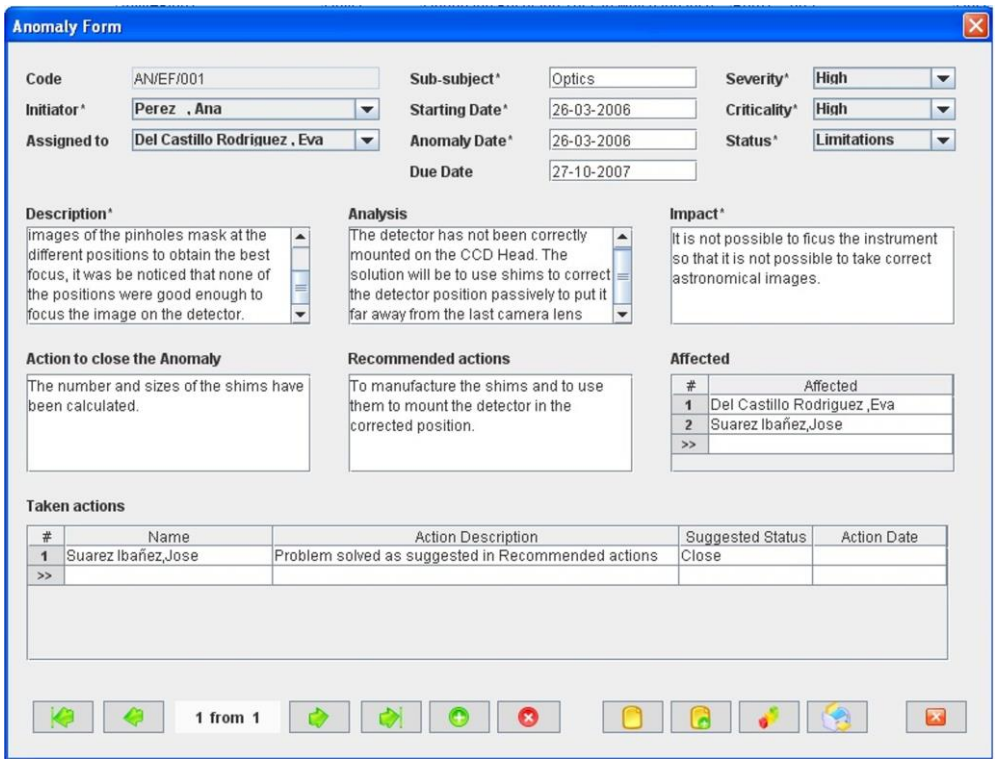


Figure 131: *Anomalies Form showing only the selected record*

B. Add a new record.

In the Anomalies Form, new Anomalies can be created in two different ways:

B.I. Starting an empty Anomaly.

In the Anomalies Form, click the *Add* button to add a new record,

A new window will appear,

⇒ select the System PT element code in the *System* combo box (only the PT elements at system level can be selected.),

⇒ click *Accept*,

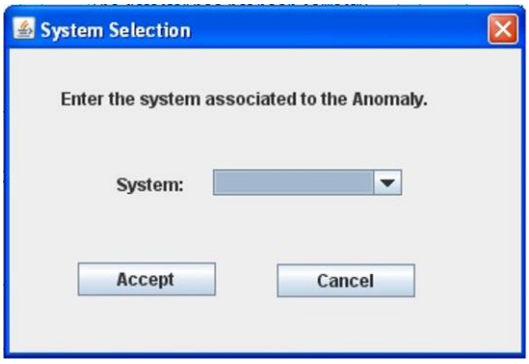


Figure 132: *Anomalies Form*

The new Anomaly **Code** will be automatically generated as the first one available for the Anomaly Product Tree element code selected.

All Anomalies Codes follow the same pattern as described below:

AN/PT/nnn

where,

AN: Anomaly (these characters are always the same for all Anomalies)

PT: Product Tree Element code

nnn: Sequence number that will be automatically generated by the application

The Anomaly Code is unique for each Anomaly.

The Requirement code convention is defined before starting to use GECO. More information about it can be found in section 18.

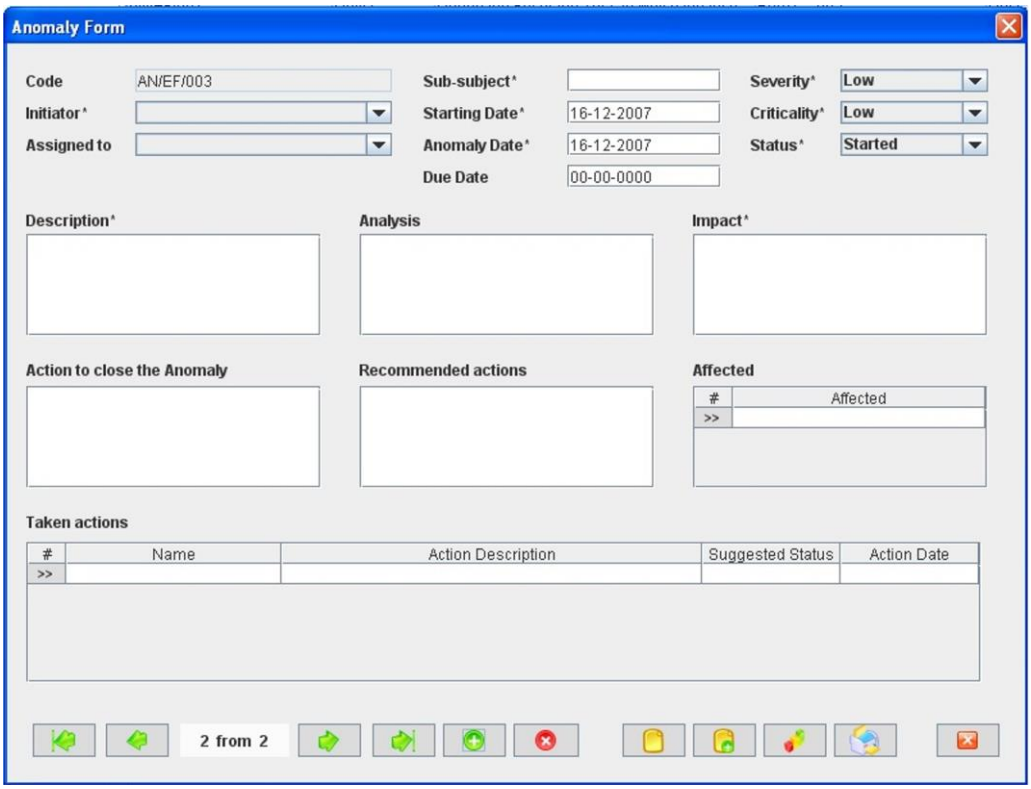


Figure 133: *Anomalies Form once the PT System has been chosen as shown in Figure 132*

B.II. Cloning an already existing Anomaly.

In the Anomalies Form, click the *Copy* button to clone the Anomaly that is currently selected in the form,

The new Anomaly **Code** will be automatically generated as the first one available for the same Anomaly Product Tree element code of the Anomaly that has been cloned.

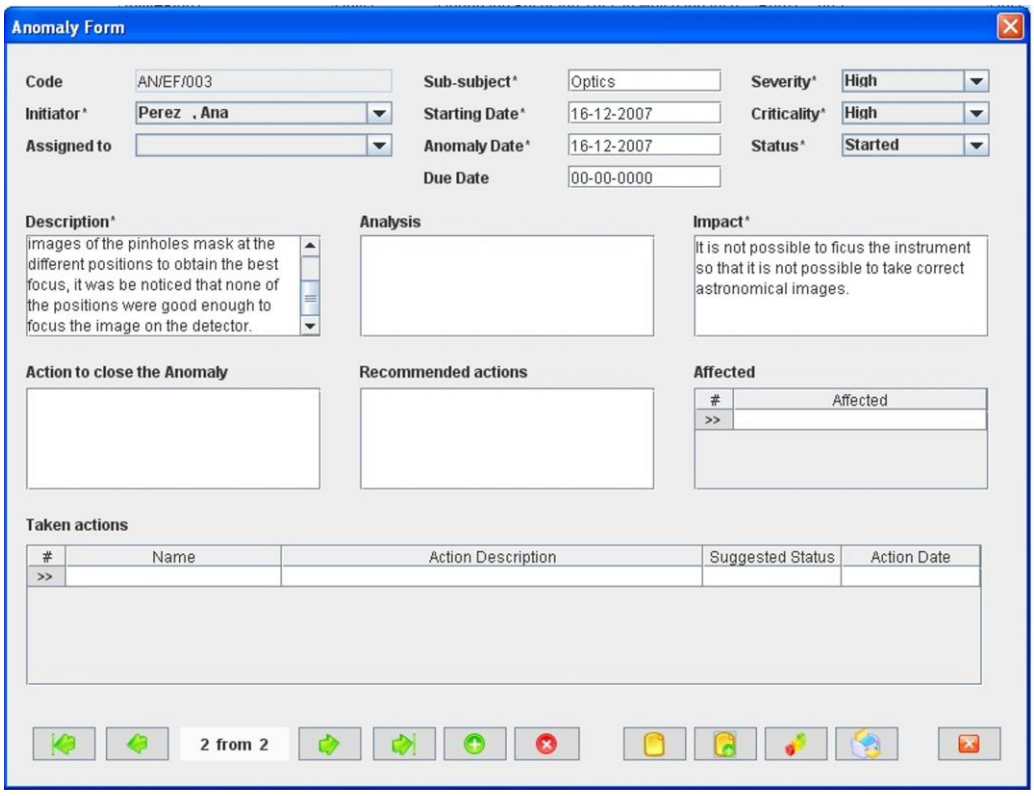


Figure 134: *Anomalies Form ready to introduce a new Anomaly by cloning an existing record*

C. Fill in the new record.

In the Anomalies Form, the mandatory fields that must be filled in are the following ones:

- **Code.** The Anomaly code is automatically generated by the application and cannot be modified.
- **Sub-subject.** Indicate what subsystem (or group inside the organization) is affected by the Anomaly. This is a text field with a maximum length of 20 characters.
- **Initiator.** Identify the person that is creating the Anomaly. All persons in the organization that have been previously introduced as Users in the application (see section 15) can be selected from the combo box.
- **Starting date.** Indicate the date when the Anomaly is being created. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.
- **Anomaly date.** Indicate the date when the Anomaly has occurred. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.
- **Severity combo box.** Select the Anomaly severity (i.e., the impact that the occurrence of the anomaly has had in the system) among the options offered in the Severity combo box, that include:
    - *High*
    - *Medium*

- *Low*

By default, the classification is *"Low"*.

- **Criticality combo box.** Select the Anomaly criticality (i.e., the impact that the anomaly or the reoccurrence of the anomaly can have in the system) among the options offered in the Criticality combo box, that include:
  - *High*
  - *Medium*
  - *Low*

  By default, the classification is *"Low"*.
- **Status combo box.** Select the Anomaly status among the options offered in the Status combo box, that include:
  - *Started*
  - *Under analysis*
  - *Rejected*
  - *Closed*
  - *Limitation*

  When the Anomaly is created, the default status is *"Started"*.
- **Description.** Describe the Anomaly in detail: what happened, what actions were performed, etc. This is a text field with a maximum length of 300 characters.
- **Impact.** Describe the impact that the Anomaly has had in the system functionality. This is a text field with a maximum length of 250 characters.

The rest of the fields that can be optionally filled are:

- **Analysis.** If any analysis of the Anomaly has already been done, introduce a description of it in this box. This is a text field with a maximum length of 300 characters.
- **Recommended actions.** Describe what actions are recommended to investigate the anomaly. This is a text field with a maximum length of 300 characters.
- **Affected.** Identify the persons that can be affected by the Anomaly (select as many as required). The affected persons will receive a notification email related to the Anomaly modifications. All persons in the organization that have been previously introduced as Users in the application (see section 15) can be selected from the combo box.

The fields *Assigned to, Estimated date, Action to close the Anomaly* and all the fields under *Taken actions* should not be filled at the creation of the Anomaly. The first two fields must be filled at the ARB where the Anomaly is reviewed. The *Taken Actions* fields must be filled by the users (if the "*Assigned to"* field changes) who are doing actions to investigate the Anomaly. Eventually, the Action to close the Anomaly must be filled at the ARB where the Anomaly is ended (i.e., *Status* changed to *"Closed"* or *"Limitation"*).

D. Save the new record.

In the Anomalies Form, click the *Save* button to save the record,

If the current record is not saved, the new record will not be created.

Once the Anomaly is saved, the application will send an email to notify that the Anomaly has been created.

> "*The current status of the Anomaly* (Code) *is* (new status)" to be sent to the Initiator, the person assigned to do it (if exits) and the affected persons (if exits).

E. Close the Anomalies Form

In the Anomalies Form, click the *Exit* button to exit the form,

If the record has been saved, the Anomalies Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 135: *Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving.

⇒ Click *NO* to come back to the Anomalies Form.

13.3 Selecting a particular Anomaly

In the Main window, the form view of a particular Anomaly can be opened in two different ways:

A. Going through the Forms Menu.

In the Main window, select *Forms* Menu ⇒*Anomalies* Form or press *ALT+O+A*.

In order to find a particular Anomaly, the following actions can be done:

⇒ Use the arrows for moving among the Anomalies currently selected in the form,

To go to the first record of the selected ones,

To go to the previous record to the current one,

To go to the next record to the current one and

To go to the last record of the selected ones

⇒ Use the *Filter* button to filter/un-filter the set of Anomalies currently selected in the form,

A new window will appear:

⇒ Click *Data filter activated* box to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be recorded),

⇒ select in the *Field* combo box the desired field to filter the data,

⇒ select in the *Op* combo box how the previously selected field must match the defined *Value* (i.e., "*starting with*", "*contains*", *"is",* "*ending by*")

⇒ write in the *Value* text field the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

⇒ define as many filters as wanted (by adding new lines),

⇒ click *Accept*,

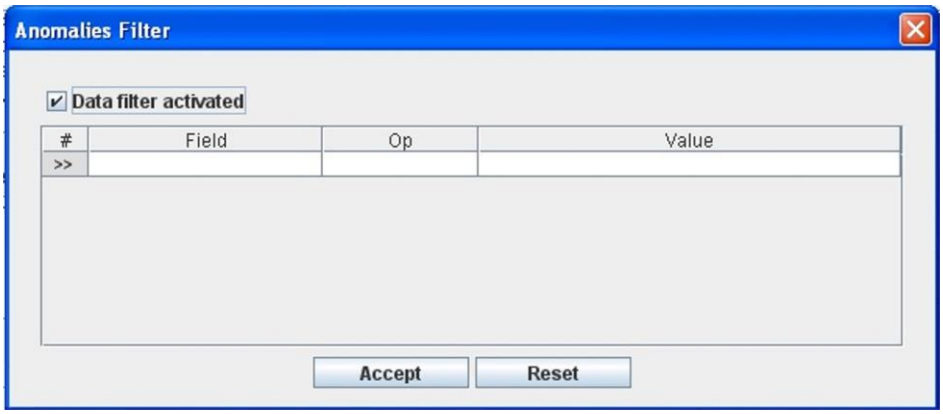


Figure 136: *Anomalies Filter to select the desired documents by different fields*

B. Selecting the Anomaly in the Anomalies View.

In the Main window, click the *Views Menu* ⇒*Anomaly View* or press *ALT+V+A*.

In order to constrain (by Product Tree Element or by filtering) the number of Anomalies listed in the view, see the steps to be followed in section 4.2.

Select the desired Anomaly among the Anomalies listed in the table at the right side of the window by double-clicking with the left button of the mouse.

13.4 Modifying existing Anomalies

The Anomaly to be modified must be already selected, which will be done by following the steps described in section 13.3.

In the Anomalies Form, the following steps must be done in order to modify the selected Anomaly.

A. Modify the desired fields.

Make the desired changes in the Anomaly fields, taking into account the constrains identified in section 13.2, numbered item C) and, also, that the *Code*, *Initiator*, *Starting date* and *Anomaly date* fields cannot been modified once the Anomaly has been already created.

All the rest of the fields can be modified and, in particular, the following fields must be filled after the ARB meeting where the Anomaly is presented:

- **Assigned to.** Identify the person that is going to investigate the Anomaly. All persons in the organization that have been previously introduced as Users in the application (see section 15) can be selected from the combo box.
- **Due date.** Indicate the date when the Anomaly should be solved. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.

Later, each responsible (i.e., person assigned to an Anomaly) must introduce the actions performed by him/her into the fields under *Taken actions*. The following fields must be filled:

- **Name.** Identify the person that is describing the taken action. All persons in the organization that have been previously introduced as Users in the application (see section 15) can be selected from the combo box.
- **Action Description.** Describe the taken action in detail: the action done, the observed result, etc. This is a text field with a maximum length of 200 characters.
- **Suggested status combo box.** Suggest a new status for the Anomaly among the options offered in the Suggested status combo box, which includes the following ones:
  - *Monitorize*
  - *Close*
  - *Limitation*

  There is no default option for the combo box.
- **Action date.** Indicate the date when the action has been done. This is a date field with the following format: **dd-mm-yyyy**, where dd: day, mm: month and yyyy: year.

At the ARB when the Anomaly is finalized, the following field must be filled:

- **Action to close the anomaly.** Describe the action/s that justify changing the status of the anomaly as Closed. This is a text field with a maximum length of 300 characters.

B. Save the modified record.

In the Anomaly Form, click the *Save* button to save the record,

If the record is not saved, the changes will not be applied.

Once the Anomaly is saved, the application will send an email to notify that a modification has been done to the Anomaly. This notification could be the following ones depending of the modification done

"*The current status of the Anomaly* (Code) *is* (new status)" to be sent to the Initiator, the person assigned to do it and the affected persons whenever the status is changed.

"*The Assigned person to the Anomaly* (Code) *has been changed*" to be sent to the Initiator, to the previous responsible and to the new one.

"*The due date of the Anomaly* (Code) *has been changed*" to be sent to the responsible.

C. Close the Anomalies Form

In the Anomalies Form, click the *Exit* button to exit the form,

If the record has been saved, the Anomalies Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 137: *Warning Window reporting that changes have not been saved*

⇒ Click *YES* to exit without saving.

⇒ Click *NO* to come back to the Anomalies Form.

13.5 Printing an Anomaly

The Anomaly to be printed must be already selected, which will be done by following the steps described in section 13.3.

In the Anomaly Form, the following step must be done in order to print the selected Anomaly.

C. Print the record.

In the Anomaly Form, click the *Print button* to print the record,

A preview of the record to be printed will appear.

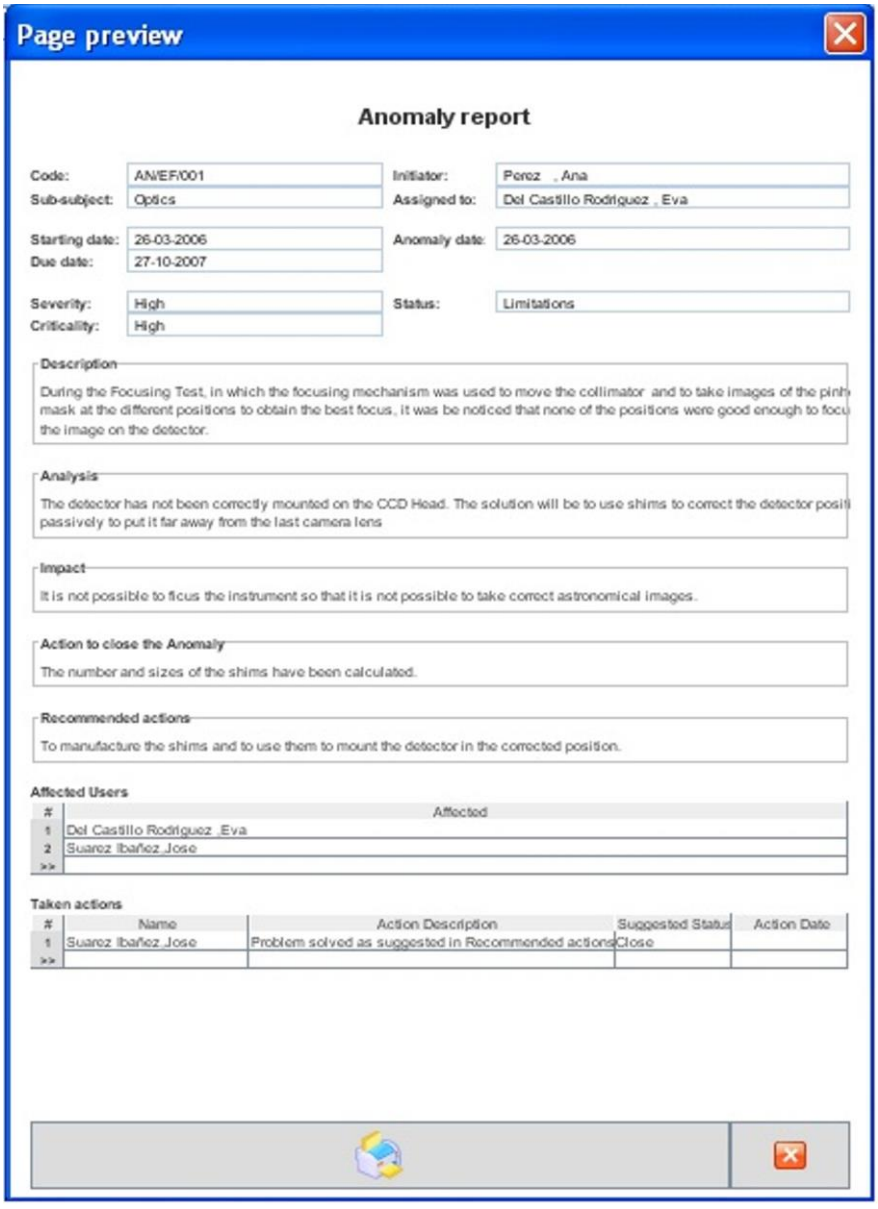


Figure 138: *Preview window for the Anomaly to be printed.*

⇒ Select the *Print button* to print the record,

or,

⇒ Select *Cancel button* to come back to the Anomaly form without printing.

If the *Print button* is selected, the application will look for the printers connected to your computer and the print menu will be opened.

A new window will appear,

⇒ select in the *Name combo box* the printer to be used,

⇒ define the desired properties for this job,

⇒ click *Accept*,

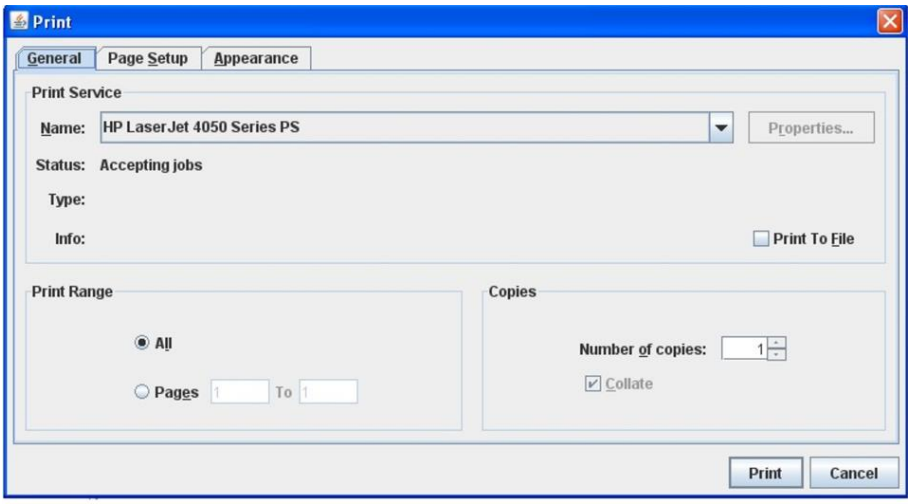


Figure 139: *Print Dialog. The selected record will be printed*

13.6 Deleting an Anomaly

The Anomaly to be deleted must be already selected, which will be done by following the steps described in section 13.3.

In the Anomalies Form, the following steps must be done in order to delete the selected Anomaly.

A. Delete the record.

In the Anomalies Form, click the *Delete* button to delete the record,

A new window will appear to ask the user if he/she really wants to delete the record.

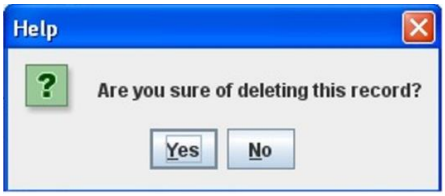


Figure 140: *Warning Window to check if the user wants to delete the record*

⇒ Click *YES* to delete the record.

⇒ Click *NO* to exit without deleting.

14. RAMS COMPONENTS FOR REPAIRABLE SYSTEMS

14.1 What is a RAMS component?

RAMS stands for Reliability, Availability, Maintainability and Safety. RAMS analyses must be performed at all stages of a project to ensure that the system design meets the availability, reliability, maintainability and safety requirements targets established in the RAMS requirements. With this tool we intend to calculate the project, system or subsystems availability (in terms of global MTBF and MTTR) and reliability (in terms of percentage of time that the project, system or subsystem is available to perform its function).

The first step to perform any RAMS analysis is to breakdown the system into subsystems and each subsystem into components or elements, that is, into RAMS components.

RAMS components in this tool can be referred to:

- The hierarchically lowest elements of each system or subsystem to be analyzed in terms of availability and reliability (typically, Product tree elements or parts). These elements are named as "items" in this section.
- A set of n equal items with a functional relationship or configuration among them. These elements are named as "components" in in this section. The number of items can be just two or more (n), to be defined by the user in the component form.
- The subsystems comprised of several components (component set) with a functional relationship or configuration among them; in this case, we call "children" to those elements and "parents" to those subsystems (the same way as we do for parent and children requirements). In this case, a component set representing a subsystem will be composed by several components.
- The systems comprised of several subsystems with a functional relationship or configuration among them; in this case, we call "children" to those subsystems and "parents" to their correspondent systems. In this case, a component set representing a system will be composed by several subsystems.
- A project comprised of several systems with a functional relationship or configuration among them; in this case, we call "children" to those systems and "parent" to their correspondent project. In this case, a component set representing a project will be composed by several systems.

This hierarchically chain can have as many levels as required.

14.1.1 Repairable systems

When studying system reliability and availability, non-repairable systems, missions or products are treated differently from repairable systems, missions or products. Some of the metrics, tools and mathematical models used for one type are not applicable to the other.

Repairable systems are those that receive maintenance actions that restore/renew system components when they fail to the original operating state. For such systems the time of operation is not continuous, since their operating life cycles are described by a sequence of up and down states. In this case, the important variables to be determined are the mean time between failures (MTBF) and the mean time to repair or MTTR, as well as the system availability (or the opposite concept, unavailability/downtime).

The calculations to estimate the global system MTBF and MTTR in order to verify the compliance of the availability requirement are performed with the aid of a mathematical model that we call "Availability model".

The **parameters** that are used to build availability model in Repairable systems are:

- Failure Rate (λ): total number of failures within an item population, divided by the total operating time expended by that population, during a particular measuring interval, under stated conditions. In this tool, the failure rate is considered constant.
- Mean Time Between Failures (MTBF): the MTBF for a system is the mean time between two consecutive failures of the system.
- Mean Time To Repair (MTTR): The MTTR for a system is the mean time spent in unplanned (corrective) maintenance to repair the system.
- Availability: the probability that an item or system is "up" (working) at any random instant in time.
- Unavailability or Downtime: the probability that an item or system is "down" (not working) at any random instant in time.

The basic **assumptions** made in the tool calculations are:

- Elements must be completely independent.
- Failure Rate is constant, that is, all calculations are made in a steady state of the system.
- Mean Time Between Failures must be introduced in the tool "normalized" to the operation time of the system. [2]
- Stand-by redundancy assumes that active failure rates are constant and passive and switching failure rates are assumed to be zero.

The equations used to calculate these parameters for a system from its components depend on the arrangement **configuration** of those components among each other. The main configurations are:

- Serial: The system will fail if one of its components fails.
- Active redundancy or "m out of n": The system with n redundant components will work if either m-out-of-n component work (m<n). The system fails if (n-m+1) components fail. It is called "active" redundancy because the n components are active or working at the same time. "Parallel" redundancy is a special case of active redundancy with m=1 (two active independent components working).
- Stand-by redundancy: refers to m out of n units working and (n-m) "waiting" in stand-by (idle, as opposite to active). The stand-by units start to work when active units fail.

[2] *For example, if the MTBF given by the manufacturer for a component is 1000h of continuous operation (24h per day) but that component is active in the studied system only during 6 hours per day, the normalized MTBF of that component to be introduced in the tool will be 4000h ((24/6) *1000).*

14.2 Creating a RAMS component of repairable systems

Starting at the Main Window of the application,

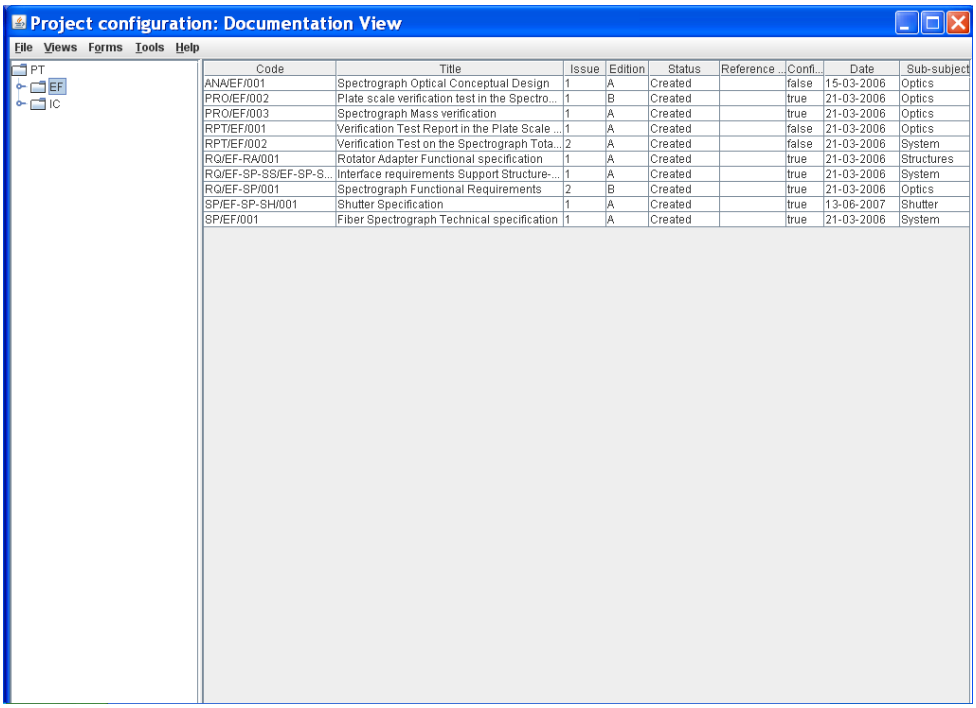


Figure 141: *Main window of the application*

the following steps must be executed in order to create a new RAMS component:

A. Open the RAMS Repairable System form.

In the Main window, select *Forms* Menu ⇒ *RAMS Repairable System* Form.

The RAMS component form will be opened with all available records selected.

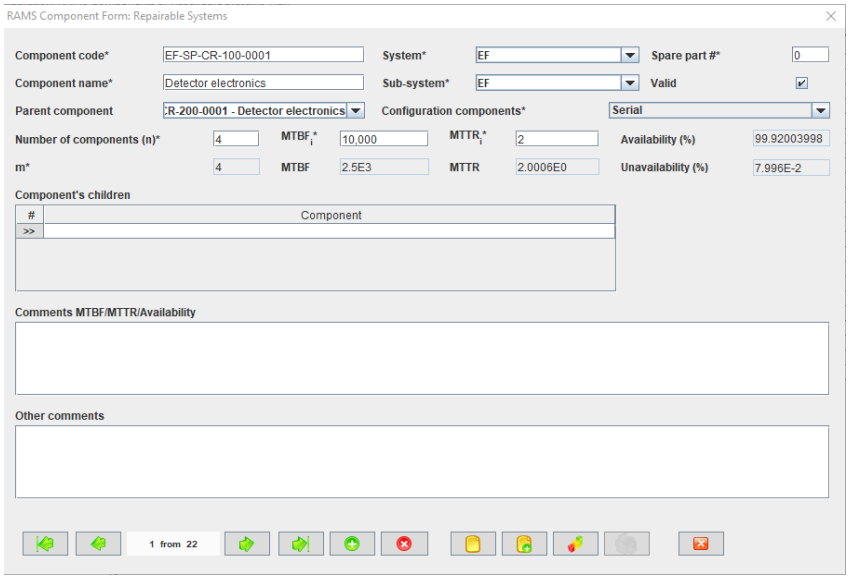


Figure 142: *RAMS component form for repairable systems showing all the selected records*

B. Add a new record.

In the RAMS Repairable System Form, new RAMS component can be created in two different ways:

B.I. Starting an empty RAMS component.

In the RAMS Repairable System Form, click the *Add* button to add a new record,

A new RAMS component form will be opened empty and ready to be filled in.

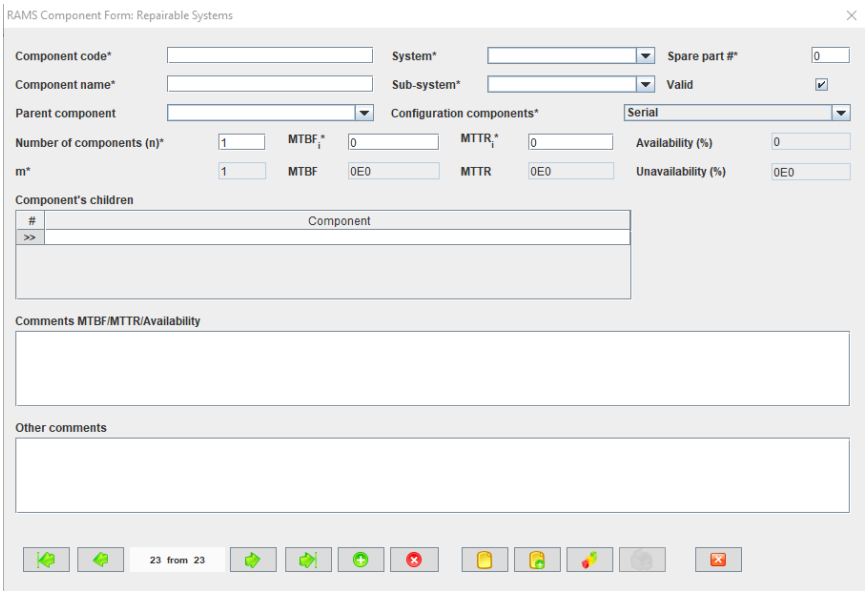


Figure 143: *RAMS Repairable System Form to introduce a new RAMS component.*

B.II. Cloning an already existing RAMS component.

In the RAMS Repairable System Form, click the *Copy* button to clone the RAMS component that is currently selected in the form,

A new RAMS component form will be opened with several fields cloned from the previous record and ready to be completed.

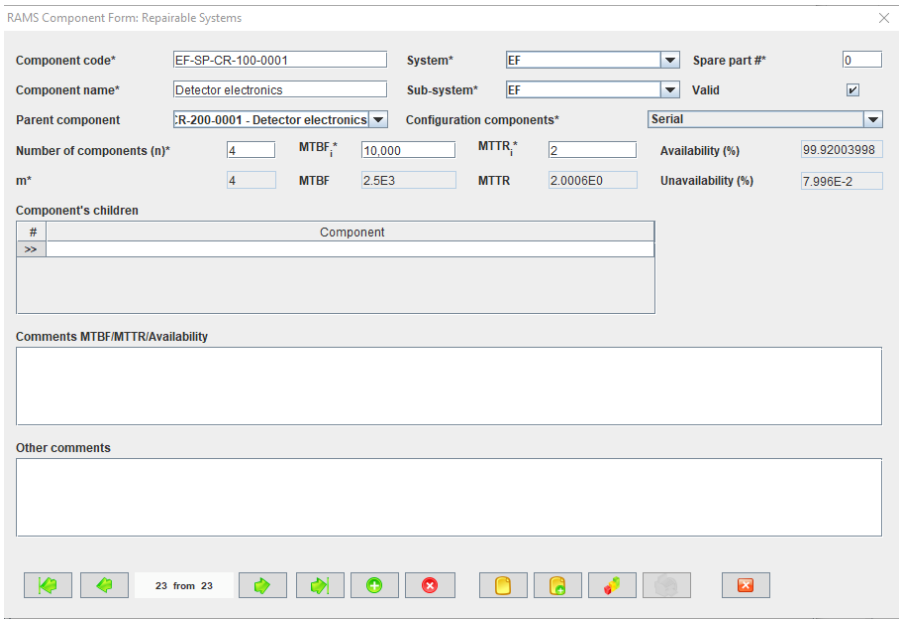


Figure 144: *RAMS Repairable System form ready to introduce a new RAMS component by cloning an existing record*

C. Fill in the new record.

In the RAMS Repairable System Form, the mandatory fields to be filled in are:

- **Component code.** Indicate the code of the component or component set. The code is unique for each component/component set. This is a text field with a maximum length of 80 characters.
- **Component name.** Indicate the name of the component or component set. This is a text field with a maximum length of 250 characters.
- **System combo box.** Select, among the options offered in the system combo box, the system the component or component set belongs to.
- **Sub-system combo box.** Select, among the options offered in the sub-system combo box, the subsystem (PT element) the component or component set belongs to.
- **Spare part #.** Indicate the number of spares foreseen for the component or component set. This is an integer field.
- **Configuration components combo box.** Select from the combo box the arrangement configuration of those components among each other (see 14.1 for further details).

  There are some restrictions on the configuration of a set of components:

  - For the Standby redundancy configuration, the number of components required to be working for the system to work (field m) is limited to 1.
- **Number of components (n)**. In case of a component, (n) indicates the number of equal items of that component and it is filled in manually (see 14.1 for further details). In case of a component set (i.e. a subsystem), the application will calculate

automatically the number of "children components" that set has (the ones we have previously introduced in the application). This is an integer field.

- **m.** Indicates the minimum number of component items necessary for the system to function properly. It applies to both Active redundancy and Standby redundancy configuration. This is an integer field.
- **MTBF$_i$.** Indicates the Mean Time Between Failures of each equal item in hours. In case of a component set, this field is disabled and the application automatically displays a zero value to indicate that it is not being used for the calculations. This is a real number field.
- **MTTRi.** Indicates the Mean Time to Repair of each equal item in hours. In case of a component set, this field is disabled and the application automatically displays a zero value to indicate that it is not being used for the calculations. This is a real number field.

The following fields are disabled because they will be filled automatically by the application:

- **MTBF.** Indicates the Mean Time Between Failures of the component or component set in hours. In the case of components, this field is automatically calculated by the application from the MTBFi entered by the user and considering the arrangement of the components among each other. In the case of "component set", this field is automatically calculated by the application from the children parameters and considering the arrangement of the components among each other. This is a real number field.
- **MTTR.** Indicates the Mean Time to Repair of the component or component set in hours. In the case of components, this field is automatically calculated by the application from the MTBFi and MTTRi entered by the user and considering the arrangement of the components among each other. In the case of "component set", this field is automatically calculated by the application from the children parameters and considering the arrangement of the components among each other. This is a real number field.
- **Availability.** Indicate the availability (A = MTBF/(MTBF + MTTR)) of the component or component set (in percentage). This field is calculated automatically by the application considering the arrangement of the components among each other. This is a % number field.
- **Unavailability.** Indicate the unavailability (U = 100 - A) of the component or component set (in percentage). This field is calculated automatically by the application considering the arrangement of the components among each other. This is a % number field.

The rest of the fields that can be optionally filled in are:

- **Valid.** Indicate if the component is valid or not. To be valid means that the component will be used for the MTBF/MTTR/Availability calculations of the system.
- **Parent component.** Indicates the component set/subsystem to which this component or component set belongs. Select from the combo box between the components already defined in the application.

- **Component's children.** Only in case of a component set, this field identifies the components or subsystems that comprise this component set. In the combo box, all components or component sets existing in the application can be selected.
- **Comments MTBF/MTTR/Availability.** This is a text field (with no limited length) to include comments related to the MTBF/MTTR/Availability calculations.
- **Other Comments.** This is a text field (with no limited length) to introduce any additional comment related to the component.

D. Save the new record.

In the RAMS Repairable System Form, click the *Save* button to save the record,

If the current record is not saved, the new record will not be created.

E. Close the RAMS Repairable System Form

In the RAMS Repairable System Form, click the *Exit* button to exit the form,

If the record has been saved, the RAMS Repairable System Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 145: *Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving.

⇒ Click *NO* to come back to the RAMS Repairable System Form.

14.3 Selecting a particular RAMS component

In the Main window, the form view of a particular RAMS component can be opened in two different ways:

A. Going through the Forms Menu.

In the Main window, select *Forms* Menu ⇒ *RAMS* Repairable System Form.

In order to find a particular RAMS component, the following actions can be done:

⇒ Use the arrows for moving among the RAMS components currently selected in the form,

To go to the first record of the selected ones,

To go to the previous record to the current one,

To go to the next record to the current one and

To go to the last record of the selected ones

⇒ Use the *Filter* button to filter/un-filter the set of RAMS components currently selected in the form,

A new window will appear:

⇒ Click *Data filter activated* box to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be recorded),

⇒ select in the *Field* combo box the desired field to filter the data,

⇒ select in the *Op* combo box how the previously selected field must match the defined *Value* (i.e., "*starting with*", "*contains*", *"is"*, "*ending by*")

⇒ write in the *Value* text field the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

⇒ define as many filters as wanted (by adding new lines),

⇒ click *Accept*,

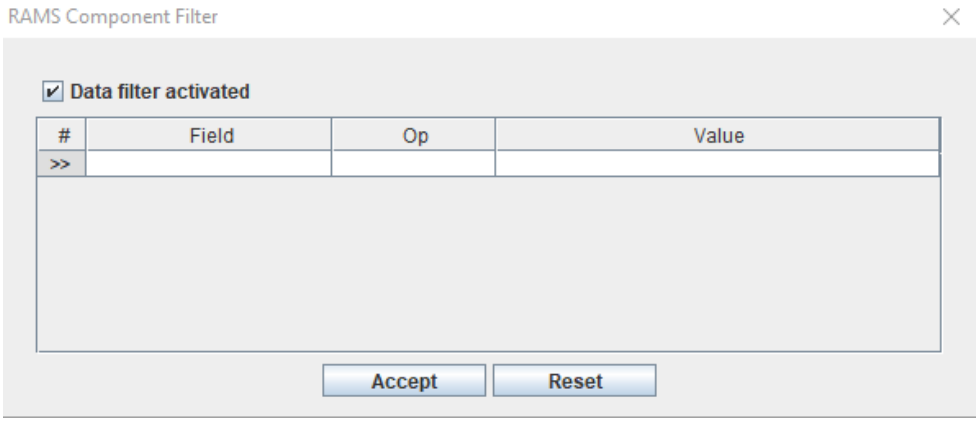


Figure 146: *RAMS component Filter to select the desired RAMS components by different fields*

B. Selecting the RAMS component in the RAMS components of Repairable System View.

In the Main window, click the *Views Menu* ⇒ *RAMS components of Repairable System View*.

In order to constrain (by Product Tree Element or by filtering) the number of RAMS components listed in the view, see the steps to be followed in section 4.2.

Select the desired RAMS component among the ones listed in the table at the right side of the window by double-clicking with the left button of the mouse.

14.4 Modifying existing RAMS component

The RAMS component to be modified must be already selected, which will be done by following the steps described in section 14.3.

In the RAMS Repairable System Form, the following steps must be done in order to modify the selected RAMS component.

A. Modify the desired fields.

Make the desired changes in the RAMS component fields, taking into account the constrains identified in section 14.2, numbered item C).

B. Save the modified record.

In the RAMS Repairable System Form, click the *Save* button to save the record,

If the record is not saved, the changes will not be applied.

In case the component belongs to a component set (i.e., it has a parent component) and the component has modified the MTBF/MTTR/Availability numbers, the application automatically recalculates the MTBF/MTTR/Availability numbers of his parent component.

C. Close the RAMS Repairable System Form

In the RAMS Repairable System Form, click the *Exit* button to exit the form,

If the record has been saved, the RAMS Repairable System Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 147: *Warning Window reporting that changes have not been saved*

⇒ Click *YES* to exit without saving.

⇒ Click *NO* to come back to the RAMS Form.

14.5 Deleting a RAMS component

The RAMS component to be deleted must be already selected, which will be done by following the steps described in section 14.3.

In the RAMS Repairable System Form, the following steps must be done in order to delete the selected RAMS component.

A. Delete the record.

In the RAMS Repairable System Form, click the *Delete* button to delete the record,

A new window will appear to ask the user if he/she really wants to delete the record.

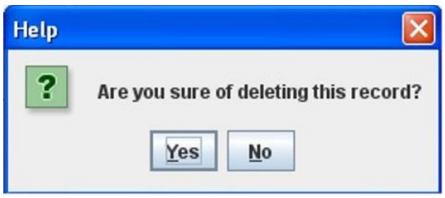


Figure 148: *Warning Window to check if the user wants to delete the record*

⇒ Click *YES* to delete the record.

⇒ Click *NO* to exit without deleting.

In case the component belongs to a component set (i.e., it has a parent component), the application automatically recalculates the MTBF/MTTR/Availability numbers of its parent component.

14.6 Exporting RAMS Repairable System calculations to XLS

In the Main window, click the *Tools Menu ⇒ Export RAMS Repairable System calculations to XLS*.

A new window will appear, where the user must, first, introduce the subsystem, the file name and path to save the xls file and, then, click *Accept*.

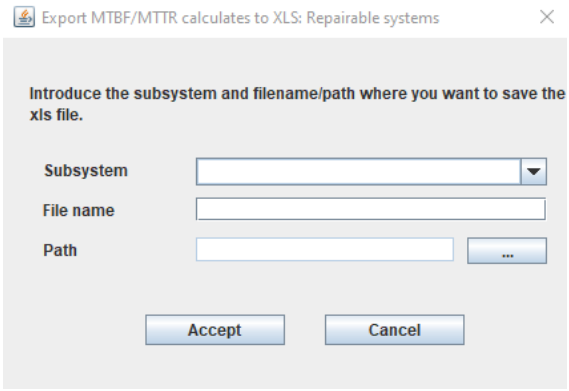


Figure 149: *Window to insert the subsystem, and filename/path to generate the xls file*

A new window (it is necessary to have a xls viewer installed) will show the MTBF/MTTR/Availability calculations of all the components that belongs to the subsystem that has been just introduced

	A	B	C	D	E	F	G	H	I	J	K	L
1	System	Sub-System	Component code		Component name	Spare part #	onfiguration component	of component	m	MTBFi (hours)	MTBF (hours)	MTTRi (I
2	EF	EF	EF-SP-CR-200-0001		Detector electronics	0,00	Standby redundancy	3,00	1,00	0,00	5,63E+08	
3	EF	EF		EF-SP-CR-100-0001	Detector electronics	0,00	Serial	4,00	4,00	10.000,00	2,50E+03	
4	EF	EF		EF-SP-CR-100-0002	Detector electronics	0,00	Serial	2,00	2,00	5.000,00	2,50E+03	
5	EF	EF		EF-SP-CR-100-0003	Detector electronics	0,00	Serial	3,00	3,00	5.000,00	1,67E+03	
6	EF	EF	EF-SP-CR-300-0002		Detector electronics	0,00	Serial	4,00	4,00	15.000,00	3,75E+03	
7	EF	EF	EF-SP-CR-300-0003		Detector electronics	0,00	Active redundancy	3,00	2,00	5.000,00	1,39E+06	
8												
9												
10												

Figure 150: *After entering the subsystem and filename/path, this window will show the result of the search, which will include all the MTBF/MTTR/Availability calculations of all the components for the selected subsystem.*

15. RAMS COMPONENTS FOR SYSTEM WITHOUT REPAIR

15.1 What is a RAMS component?

RAMS stands for Reliability, Availability, Maintainability and Safety. RAMS analyses must be performed at all stages of a project to ensure that the system design meets the availability, reliability, maintainability and safety requirements targets established in the RAMS requirements. With this tool we intend to calculate the project, system or subsystems availability (in terms of global MTBF and MTTR) and reliability (in terms of percentage of time that the project, system or subsystem is available to perform its function).

The first step to perform any RAMS analysis is to breakdown the system into subsystems and each subsystem into components or elements, that is, into RAMS components.

RAMS components in this tool can be referred to:

- The hierarchically lowest elements of each system or subsystem to be analyzed in terms of availability and reliability (typically, Product tree elements or parts). These elements are named as "items" in this section.
- A set of n equal items with a functional relationship or configuration among them. These elements are named as "components" in in this section. The number of items can be just two or more (n), to be defined by the user in the component form.
- The subsystems comprised of several components (component set) with a functional relationship or configuration among them; in this case, we call "children" to those elements and "parents" to those subsystems (the same way as we do for parent and children requirements). In this case, a component set representing a subsystem will be composed by several components.
- The systems comprised of several subsystems with a functional relationship or configuration among them; in this case, we call "children" to those subsystems and "parents" to their correspondent systems. In this case, a component set representing a system will be composed by several subsystems.
- A project comprised of several systems with a functional relationship or configuration among them; in this case, we call "children" to those systems and "parent" to their correspondent project. In this case, a component set representing a project will be composed by several systems.

This hierarchically chain can have as many levels as required.

15.1.1 Systems without Repair (or non- repairable systems)

When studying system reliability and availability, non-repairable systems, missions or products are treated differently from repairable systems, missions or products. Some of the metrics, tools and mathematical models used for one type are not applicable to the other.

Non-repairable systems are those that are not to be repaired until the system is unavailable. Examples of these systems are "one-shot" devices such as a light bulb, a pacemaker or a missile to be launched. For such systems the concepts managed are the time up to the first failure, MTTF, or operation time, as well as the system reliability (or the opposite concept, unreliability/probability of failure).

The calculations to estimate the global system MTTF in order to verify the compliance of the reliability requirement are performed with the aid of a mathematical model that we call "Reliability model".

The **parameters** that are used to build availability model in non- repairable systems are:

- Failure Rate (λ): total number of failures within an item population, divided by the total operating time expended by that population, during a particular measuring interval, under stated conditions. In this tool, the failure rate is considered constant.
- Mean Time To (first) Failure (MTTF): the MTTF for a system is the mean time for the system to fail.
- Reliability: the probability of being able to perform under given conditions for a given time interval.
- Probability of Failure or Unreliability: the probability of failure / not being able to perform under given conditions for a given time interval.

The basic **assumptions** made in the tool calculations are:

- Elements must be completely independent.
- Failure Rate is constant, that is, all calculations are made in a steady state of the system.
- The probability of failure by a given time is assumed to follow a negative exponential distribution.
- Mean Time To Failure must be introduced in the tool "normalized" to the operation time of the system. [3]
- Stand-by redundancy assumes that active failure rates are constant and passive and switching failure rates are assumed to be zero.

The equations used to calculate these parameters for a system from its components depend on the arrangement **configuration** of those components among each other. The main configurations are:

- Serial: The system will fail if one of its components fails.
- Active redundancy or "m out of n": The system with n redundant components will work if either m-out-of-n component work (m<n). The system fails if (n-m+1) components fail. It is called "active" redundancy because the m components are active or working at the same time. "Parallel" redundancy is a special case of active redundancy with m=1 (two active independent components working).
- Stand-by redundancy: refers to m out of n units working and (n-m) "waiting" in stand-by (idle, as opposite to active). The stand-by units start to work when the active units fail.

[3] *For example, if the MTTF given by the manufacturer for a component is 1000h of continuous operation (24h per day) but that component is active in the studied system only during 6 hours per day, the normalized MTTF of that component to be introduced in the tool will be 4000h ((24/6) *1000).*

15.2 Creating a RAMS component of system without repair

Starting at the Main Window of the application,

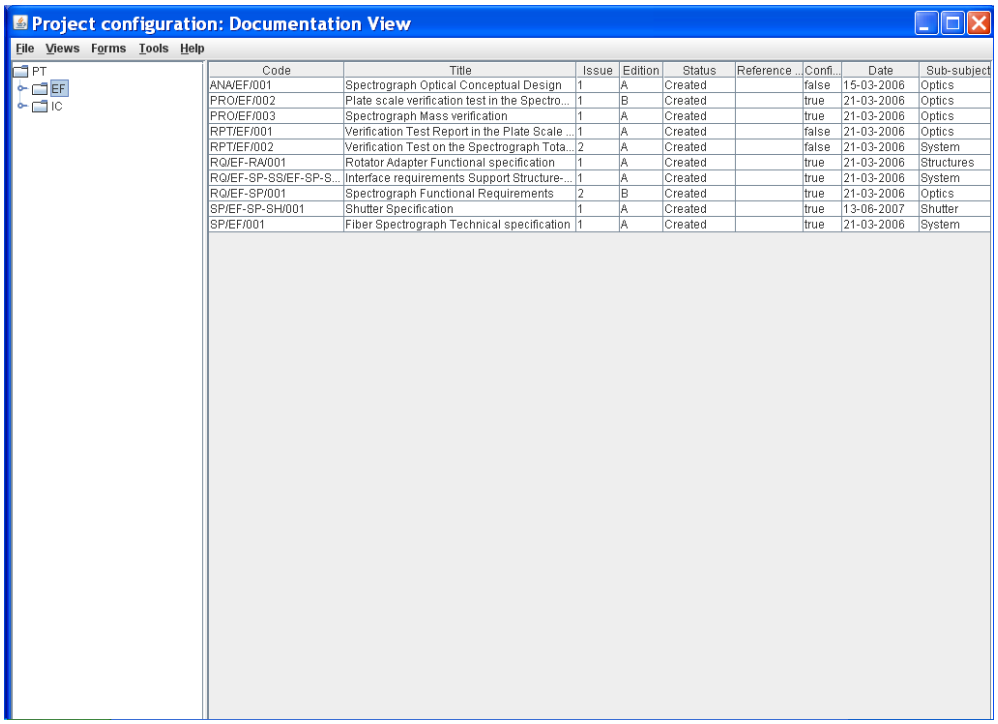


Figure 151: *Main window of the application*

the following steps must be executed in order to create a new RAMS component:

A. Open the RAMS System without Repair Form.

In the Main window, select *Forms* Menu $\Rightarrow$ *RAMS System without Repair* Form.

The RAMS component form will be opened with all available records selected.

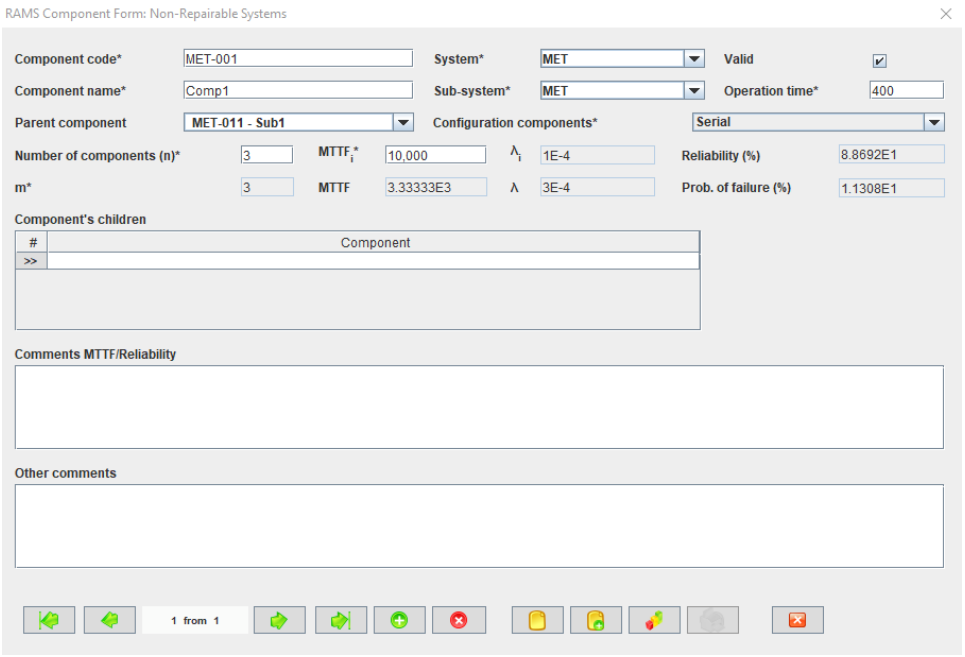


Figure 152: *RAMS System without Repair form showing all the selected records*

B. Add a new record.

In the RAMS System without Repair Form, new RAMS component can be created in two different ways:

B.I. Starting an empty RAMS component.

In the RAMS System without Repair Form, click the *Add* button to add a new record,

A new RAMS System without Repair Form will be opened empty and ready to be filled.

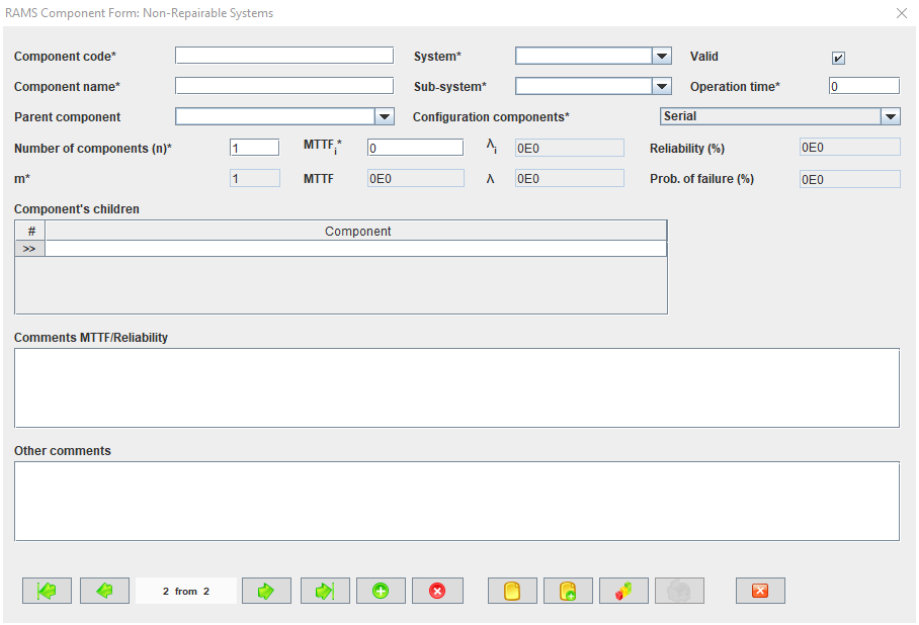


Figure 153: *RAMS System without Repair Form to introduce a new RAMS component.*

B.II. Cloning an already existing RAMS component.

In the RAMS System without Repair Form, click the *Copy* button to clone the RAMS component that is currently selected in the form,

A new RAMS System without Repair form will be opened with several fields cloned from the previous record and ready to be completed.

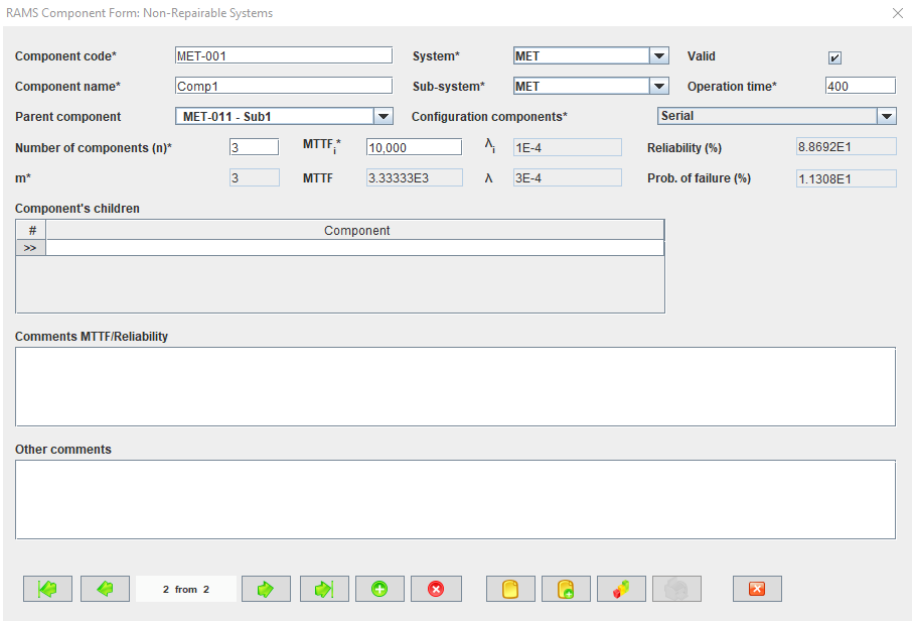


Figure 154: *RAMS System without Repair form ready to introduce a new RAMS component by cloning an existing record*

C. Fill in the new record.

In the RAMS System without Repair Form, the mandatory fields to be filled in are:

- **Component code.** Indicate the code of the component or component set. The code is unique for each component/component set. This is a text field with a maximum length of 80 characters.
- **Component name.** Indicate the name of the component or component set. This is a text field with a maximum length of 250 characters.
- **System combo box.** Select, among the options offered in the system combo box, the system the component or component set belongs to.
- **Sub-system combo box.** Select, among the options offered in the sub-system combo box, the subsystem (PT element) the component or component set belongs to.
- **Operation time.** Indicate the operation time of the system in hours. This is a real number field.
- **Configuration components combo box.** Select from the combo box the arrangement configuration of those components among each other (see 15.1 for further details).

  There are some restrictions on the configuration of a set of components:

  - For the Standby redundancy configuration, the number of components required to be working for the system to work (field m) is limited to 1.
- **Number of components (n)**. In case of a component, (n) indicates the number of equal items of that component and it is filled in manually (see 14.1 for further details). In case of a component set (i.e. a subsystem), the application will calculate automatically the number of "children components" that set has (the ones we have previously introduced in the application). This is an integer field.
- **m.** Indicates the minimum number of component items necessary for the system to function properly. It applies to both Active redundancy and Standby redundancy configuration. This is an integer field.
- **$MTTF_i$.** Indicates the Mean Time to Failure of each equal item in hours. In case of a component set, this field is disabled and the application automatically displays a zero value to indicate that it is not being used for the calculations. This is a real number field.

The following fields are disabled because they will be filled automatically by the application:

- **MTTF.** Indicates the Mean Time to Failure of the component or component set in hours. In the case of components, this field is automatically calculated by the application from the MTBFi entered by the user and considering the arrangement of the components among each other. In the case of "component set", this field is automatically calculated by the application from the children parameters and considering the arrangement of the components among each other. This is a real number field.

- **λi.** Indicates the failure rate (1/MTTFi) of each item. This field is calculated automatically by the application. This is a real number field[4].
- **λ.** Indicates the failure rate (1/MTTF) of the component or component set. This field is calculated automatically by the application. This is a real number field.
- **Reliability.** Indicates the reliability of the component or component set (in percentage). This field is calculated automatically by the application considering the arrangement of the components among each other. This is a real number field.
- **Prob. of failure.** Indicate the probability of failure of the component or component set (in percentage). This field is calculated automatically by the application. This is a real number field.

The rest of the fields that can be optionally filled in are:

- **Valid.** Indicate if the component is valid or not. To be valid means that the component will be used for the MTTF/Reliability calculations of the system.
- **Parent component.** Indicates the component set/subsystem to which this component or component set belongs. Select from the combo box between the components already defined in the application.
- **Component's children.** Only in case of a component set, this field identifies the components or subsystems that comprise this component set. In the combo box, all components or component sets existing in the application can be selected.
- **Comments MTTF/Reliability.** This is a text field (with no limited length) to include comments related to the MTBF/Reliability calculations.
- **Other Comments.** This is a text field (with no limited length) to introduce any additional comment related to the component.

D. Save the new record.

In the RAMS System without Repair Form, click the *Save* button to save the record,

If the current record is not saved, the new record will not be created.

E. Close the RAMS System without Repair Form

In the RAMS System without Repair Form, click the *Exit* button to exit the form,

If the record has been saved, the RAMS System without Repair Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

[4] *For systems without repair, the concept of failure rate is more related to a "hazard rate", whereas for repairable systems, it means "the rate of occurrence of failures".*

Figure 155: *Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving.

⇒ Click *NO* to come back to the RAMS component Form.

15.3 Selecting a particular RAMS component

In the Main window, the form view of a particular RAM component can be opened in two different ways:

C. Going through the Forms Menu.

In the Main window, select *Forms* Menu ⇒*RAMS System without Repair* Form.

In order to find a particular RAMS component, the following actions can be done:

⇒ Use the arrows for moving among the RAMS components currently selected in the form,

To go to the first record of the selected ones,

To go to the previous record to the current one,

To go to the next record to the current one and

To go to the last record of the selected ones

⇒ Use the *Filter* button to filter/un-filter the set of RAMS components currently selected in the form,

A new window will appear:

⇒ Click *Data filter activated* box to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be recorded),

⇒ select in the *Field* combo box the desired field to filter the data,

⇒ select in the *Op* combo box how the previously selected field must match the defined *Value* (i.e., "*starting with*", "*contains*", *"is"*, "*ending by*")

⇒ write in the *Value* text field the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

⇒ define as many filters as wanted (by adding new lines),

⇒ click *Accept*,

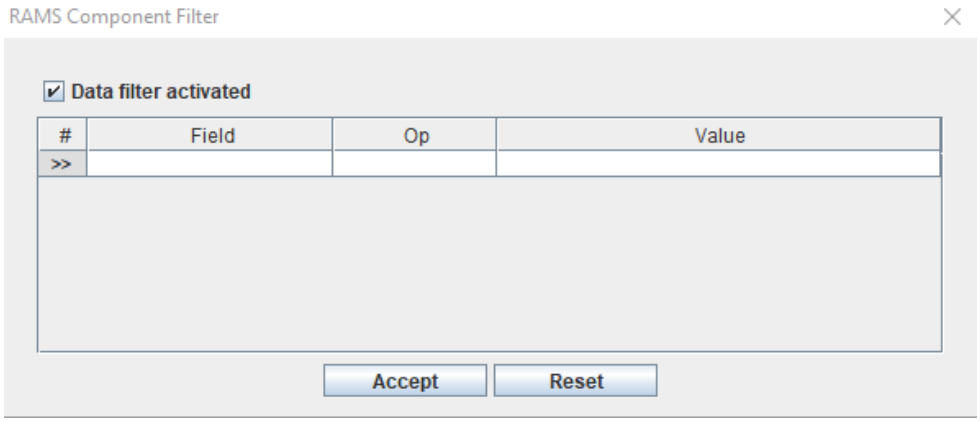


Figure 156: *RAMS component Filter to select the desired documents by different fields*

D. Selecting the RAMS component in the RAMS components of Systems without Repair View.

In the Main window, click the *Views Menu ⇒ RAMS components of Systems without Repair View*.

In order to constrain (by Product Tree Element or by filtering) the number of RAMS components listed in the view, see the steps to be followed in section 4.2.

Select the desired RAMS component among the ones listed in the table at the right side of the window by double-clicking with the left button of the mouse.

15.4 Modifying existing RAMS component

The RAMS component to be modified must be already selected, which will be done by following the steps described in section 15.3.

In the RAMS component Form, the following steps must be done in order to modify the selected RAMS component.

D. Modify the desired fields.

Make the desired changes in the RAMS component fields, taking into account the constrains identified in section 15.2, numbered item C).

E. Save the modified record.

In the RAMS System without Repair Form, click the *Save* button to save the record,

If the record is not saved, the changes will not be applied.

In case the component belongs to a component set (i.e., it has a parent component) and the component has modified the MTBF/MTTR numbers, the application automatically recalculates the MTBF/MTTR numbers of his parent component.

F. Close the RAMS System without Repair Form

In the RAMS System without Repair Form, click the *Exit* button to exit the form,

If the record has been saved, the RAMS System without Repair Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 157: *Warning Window reporting that changes have not been saved*

⇒ Click *YES* to exit without saving.

⇒ Click *NO* to come back to the RAMS Form.

15.5 Deleting a RAMS component

The RAMS component to be deleted must be already selected, which will be done by following the steps described in section 15.3.

In the RAMS System without Repair Form, the following steps must be done in order to delete the selected RAMS component.

B. Delete the record.

In the RAMS System without Repair Form, click the *Delete* button to delete the record,

A new window will appear to ask the user if he/she really wants to delete the record.

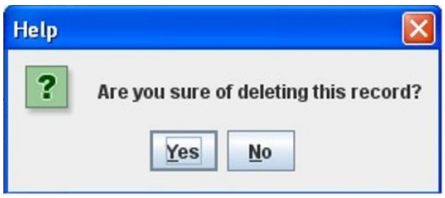


Figure 158: *Warning Window to check if the user wants to delete the record*

⇒ Click *YES* to delete the record.

⇒ Click *NO* to exit without deleting.

In case the component belongs to a component set (i.e., it has a parent component), the application automatically recalculates the MTTF/Reliability numbers of his parent component.

15.6 Exporting RAMS System without Repair calculations to XLS

In the Main window, click the *Tools Menu* ⇒ *Export rams System without Repair calculations to XLS*.

A new window will appear, where the user must, first, introduce the subsystem, the file name and path to save the xls file and, then, click *Accept*.

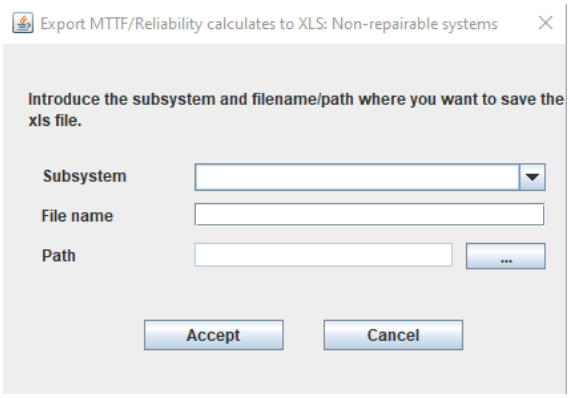


Figure 159: *Window to insert the subsystem, and filename/path to generate the xls file*

A new window (it is necessary to have a xls viewer installed) will show the MTTF/Reliability calculations of all the components that belongs to the subsystem that has been just introduced

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	System	Sub-System	Component code		Component name	onfiguration component	Operation time	of component	m	MTTFi	λi	MTTF	λ
2	MET	MET	MET-100		System	Serial	400	3,00	3,00	0,00	0,00E+00	5,57E+02	1,7
3	MET	MET		MET-011	Sub1	Serial	400	3,00	3,00	0,00	0,00E+00	6,45E+02	1,5
4	MET	MET		MET-001	Comp1	Serial	400	3,00	3,00	10.000,00	1,00E-04	3,33E+03	3,0
5	MET	MET		MET-002	Comp2	Serial	400	1,00	1,00	1.000,00	1,00E-03	1,00E+03	1,0
6	MET	MET		MET-003	Comp3	Serial	400	2,00	2,00	8.000,00	1,25E-04	4,00E+03	2,5
7	MET	MET		MET-012	Sub2	Active redundancy	400	3,00	1,00	0,00	0,00E+00	7,47E+03	1,3
8	MET	MET			Comp4	Serial	400	1,00	1,00	3.000,00	3,33E-04	3,00E+03	3,3
9	MET	MET			Comp5	Serial	400	1,00	1,00	4.000,00	2,50E-04	4,00E+03	2,5
10	MET	MET			Comp6	Serial	400	1,00	1,00	5.000,00	2,00E-04	5,00E+03	2,0
11	MET	MET		MET-013	Sub3	Standby redundancy	400	3,00	1,00	0,00	0,00E+00	9,04E+03	1,
12	MET	MET			Comp7	Serial	400	1,00	1,00	6.000,00	1,67E-04	6,00E+03	1,6
13	MET	MET			Comp8	Active redundancy	400	4,00	1,00	500,00	2,00E-03	1,04E+03	9,6
14	MET	MET			Comp9	Standby redundancy	400	4,00	1,00	500,00	2,00E-03	2,00E+03	5,0
15													

Figure 160: *After entering the subsystem and filename/path, this window will show the result of the search, which will include all the MTTF/Reliability calculations of all the components for the selected subsystem.*

16. USERS

16.1 What means to be a User in GECO

A User is commonly defined as a person, organization, or other entity that employs the services provided by a system.

In GECO, the same definition applies to the term User, so any person that is susceptible to use the application must be record as a User inside GECO.

All recorded Users will be able to start and use GECO and, also, to be selectable in the different people combo box existing in the application (such as the Document authors, the Anomaly Initiators and so on).

16.2 Creating a User

Starting at the Main Window of the application,

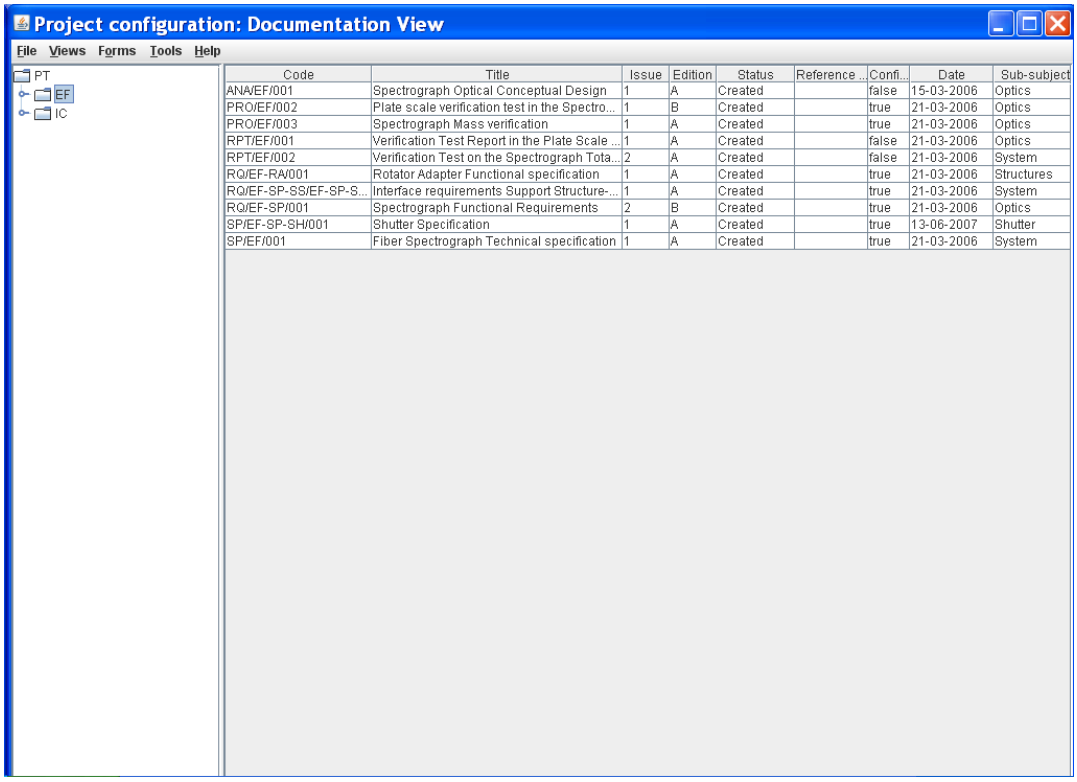


Figure 161: *Main window of the application*

the following steps must be executed in order to create a new User:

A. Open the Users Form.

In the Main window, select *Forms* Menu $\Rightarrow$ *Users* Form or press *ALT+O+U*.

The Users Form will be opened with all available records selected.

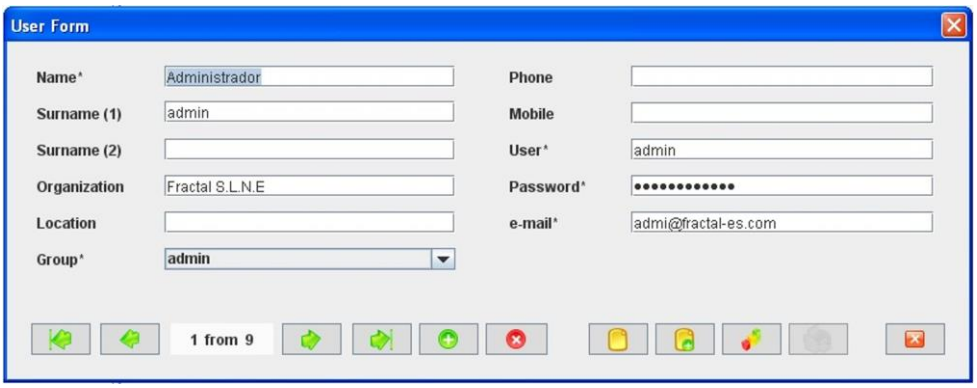


Figure 162: *Users Form showing all the selected records*

B. Add a new record.

In the Users Form, new Users can be created in two different ways:

B.I. Starting an empty User.

In the Users Form, click the *Add* button to add a new record,

A new Users Form will be opened empty and ready to be filled.

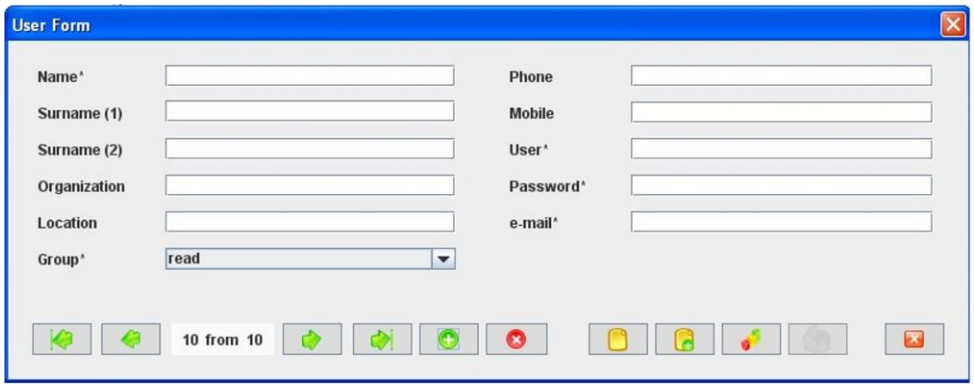


Figure 163: *User Form to introduce a new User.*

B.II. Cloning an already existing User.

In the Users Form, click the *Copy* button to clone the User that is currently selected in the form,

A new Users form will be opened with several fields cloned from the previous record and ready to be completed.

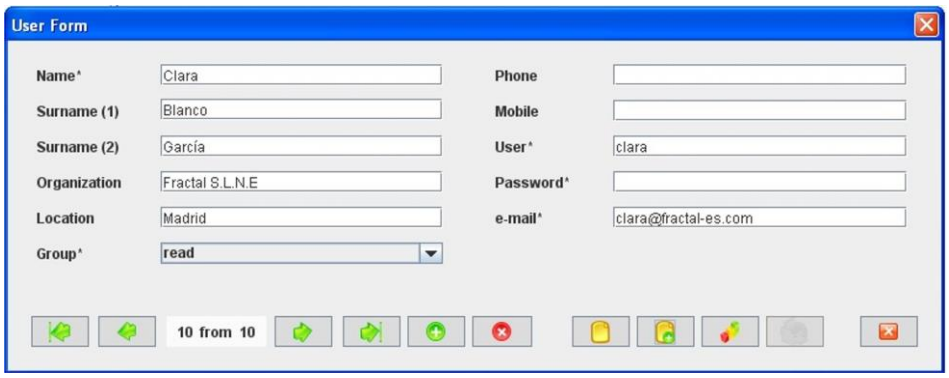


Figure 164: *Users Form ready to introduce a new User by cloning an existing record*

C. Fill in the new record.

In the Users Form, the mandatory fields that must be filled in are the following ones:

- **Name.** Indicate the first name of the User. This is a text field with a maximum length of 45 characters.
- **E-mail.** Indicate the User e-mail address. This is a text field with a maximum length of 45 characters.
- **User.** Indicate the user that is going to be used by this particular User to enter into GECO. This is a text field with a maximum length of 15 characters.
- **Password.** Indicate the password corresponding to the user entered in the previous paragraph, to enter into GECO. This is a text field with a maximum length of 32 characters.
- **Group.** Indicate the group this user belongs to. There are two options:
  - **read:** The user can only visualize the data.
  - **admin:** The user can add new records and modify and delete the existing ones.

  By default, the group is “read”.

The rest of the fields that can be optionally filled are:

- **Surname (1).** Indicate the first last name of the User. This is a text field with a maximum length of 45 characters.
- **Surname (2).** Indicate the second last name of the User. This is a text field with a maximum length of 45 characters.
- **Phone.** Indicate the User phone number. This is a text field with a maximum length of 45 characters.
- **Mobile.** Indicate the User mobile phone number. This is a text field with a maximum length of 45 characters.
- **Organization.** Indicate the User´s organization. This is a text field with a maximum length of 45 characters.

- **Location.** Indicate the User location inside the organization. This is a text field with a maximum length of 45 characters.

D. Save the new record.

In the Users Form, click the *Save* button to save the record,

If the current record is not saved, the new record will not be created.

Once the User is saved, the application will send an email to notify the creation of the User to the User's email with the following text:

"*You have been registered in GECO. Your password is* (password)"

E. Close the Users Form

In the Users Form, click the *Exit* button to exit the form,

If the record has been saved, the Users Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 165: *Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving.

⇒ Click *NO* to come back to the Users Form.

16.3 Selecting a User

In the Main window, the form view of a particular User can be opened as follows:

E. Going through the Forms Menu.

In the Main window, select *Forms* Menu ⇒ *Users* Form or press *ALT+O+U*.

In order to find a particular User, the following actions can be done:

⇒ Use the arrows for moving among the Users currently selected in the form,

To go to the first record of the selected ones,

To go to the previous record to the current one,

To go to the next record to the current one and

To go to the last record of the selected ones

⇒ Use the *Filter* button to filter/un-filter the set of Users currently selected in the form,

A new window will appear:

⇒ Click *Data filter activated* box to filter the data (if this box is not selected the filter will not be applied and the current filter already applied to the data in the form will be recorded),

⇒ select in the *Field* combo box the desired field to filter the data,

⇒ select in the *Op* combo box how the previously selected field must match the defined *Value* (i.e., "*starting with*", "*contains*", *"is",* "*ending by*")

⇒ write in the *Value* text field the text that is going to be used to filter the selected Field according to the selected option in the previous steps,

⇒ define as many filters as wanted (by adding new lines),

⇒ click *Accept*,

Figure 166: *Users Filter to select the desired documents by different fields*

16.4 Modifying existing Users

The User to be modified must be already selected, which will be done by following the steps described in section 16.3.

In the Users Form, the following steps must be done in order to modify the selected User.

A. Modify the desired fields.

Make the desired changes in the User fields, taking into account the constrains identified in section 16.2, numbered item C).

All fields in the Users form can be modified.

B. Save the modified record.

In the Users Form, click the *Save* button to save the record,

If the record is not saved, the changes will not be applied.

Once the User is saved, the application will send an email to notify the modification done to the User's email. Two different emails can be sent:

"*Your password has been modified*" when only the password has been changed

"*The User's properties have been modified*" when any other field has been changed

C. Close the Users Form

In the Users Form, click the *Exit* button to exit the form,

If the record has been saved, the Users Form will be closed.

If the record has not been saved, the following window will appear to ask the user if he/she wants to exit without saving.

Figure 167: *Warning Window reporting that changes have not been saved.*

⇒ Click *YES* to exit without saving.

⇒ Click *NO* to come back to the Users Form.

16.5 Unsubscribing/Deleting a User

The User to be unsubscribed/deleted must be already selected, which will be done by following the steps described in section 16.3.

In the Users Form, the following steps must be done in order to unsubscribe/delete the selected User.

A. Unsubscribe the user.

In the User Form, click the *Delete* button to unsubscribe the user record,

A new window will appear.

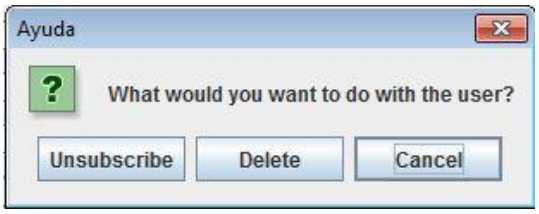


Figure 168: *Warning Window to ask unsubscribe or delete a user.*

⇒ Click *Unsubscribe* to unsubscribe the user.

⇒ Click *Cancel* to exit without unsubscribing/deleting.

Once the User has been unsubscribed, the application will send an email to notify it to the User's email with the following text: "*You have been unregistered in GECO*"

It is important to mention that, in order to maintain the history, an unsubscribed Users will not be deleted from the Person's list where they have been already selected. It means that if, for example, the unsubscribed user was the author of a document, he/she is going to be maintained as the document's author.

B. Delete the record.

In the User Form, click the *Delete* button to delete the record,

A new window will appear to ask the user what wants to do with the record.

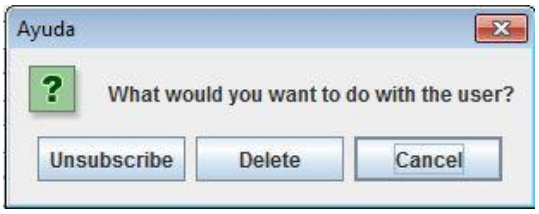


Figure 169: *Warning Window to ask what wants to do with the user record*

⇒ Click *Delete* to delete the record.

⇒ Click *Cancel* to exit without unsubscribing/deleting.

It is important to mention that the deleted Users are deleted from all Person's lists. It means that if, for example, the deleted user was the author of a document, he/she is going to disappear as the document's author.

17. ERROR MESSAGES

In this section, the error messages that could appear while the user is working with GECO are described.

1. ***"You are at the first record"***

   This error could appear in any form whenever the User is already in the first record of the set of records selected and he/she is trying to move to the previous record.

2. ***"You are at the last record"***

   This error could appear in any form whenever the User is already in the last record of the set of records selected and he/she is trying to move to the next record.

3. ***"Record has not been saved. Please, fill all the mandatory fields"***

   This error could appear in any form whenever the User is trying to save it without filling all mandatory fields, which are identified with an "*".

4. ***"You have to select a requirement document first by using the Document View"***

   This error could appear in any view whenever the User is selecting the option *Export requirements to XML* in the *Tool Menu* without pre-selecting a requirement document first.

18. SETTING-UP GECO

GECO gives some flexibility to establish the way that the data codes are defined. The Users have to decide how they want the codification convention and these decisions will be inserted in GECO database and used as constrains during the life of each particular application.

In this section, we describe the rules and restrictions to define the code conventions. It is important to mention that once they are established, they must not be changed afterwards, to avoid any incoherencies in the data.

- **PT elements:** The PT elements follow the pattern described below:

  AA-AA-AA-AA

  where

  AA: Product Tree Element acronym to be defined as any combination of alphanumeric characters (excluding the "%"). The length of this acronym is not fixed.

  -: PT Element separator

  The user must define:

  - The user must define which character is used as separator in the PT Element code to distinguish among the different PT elements levels. In this example and along this manual, we have selected the "-". The only character not allowed is "%".

  Note: The separator character that has been chosen for the PT elements must be different to the ones selected for the other elements (requirements, documents, configuration changes, non-conformities and anomalies). Otherwise, the separator character for requirements, documents, configuration changes, non-conformities and anomalies could be the same (i.e., this restriction only applies to the PT elements).

- **Requirements**: The Requirements follow the pattern described below:

  TT/PT/nnn

  where

  /: Requirements separator

  TT: Requirements type

  PT: Product Tree Element or Interface code

  nnn: Sequence number that will be automatically generated by the application

  The user must define:

  - The character to be used as separator inside the Requirements code. In this example and along this manual, we have selected the "/". The only character not allowed is the "%".

- The Requirement type, which could be any combination of alphanumeric characters (excluding "%"). In this manual, we have used "FR" (Functional Requirements) and "TR" (Technical Requirements).
- The order of the different parts of the Code. It means that all these combinations are possible: TT/PT/nnn, TT/nnn/PT, PT/nnn/TT, nnn/TT/PT, nnn/PT/TT and PT/TT/nnn.

- **Documents**: The Documents follow the pattern described below:

TT/PT/nnn

where,

/: Documents separator

TT: Document type

PT: Product Tree Element or Interface code

nnn: Sequence number that will be automatically generated by the application

The user must define:

- The character to be used as separator inside the Document code. In this example and along this manual, we have selected the "/". The only character not allowed is "%".
- The Document type, which could be any combination of alphanumeric characters (excluding "%"). At least, document types need to be defined for: Procedure, Report, Requirements and Specification documents. In this manual, we have used: ANA (Analysis), DR (Drawing), INT (Interface), MOM (Minutes of Meeting), PRO (Procedure), RPT (Report), RQ (Requirements Document), SP (Specification Document) and TEC (Technical Note).

  In particular, it must be clarified for setting-up the tool, that the acronyms shall be used for requirements and specification documents, interface documents, procedures and test reports, because these document types are used in some forms to filter the document list and, therefore, facilitate the document search.
- The order of the different parts of the Code. It means that all these combinations are possible: TT/PT/nnn, TT/nnn/PT, PT/nnn/TT, nnn/TT/PT, nnn/PT/TT and PT/TT/nnn.

- **Configuration Changes**: The Configuration Changes follow the pattern described below:

CC/PT/nnn

where,

/: Configuration Change separator

CC: Configuration Change identifier

PT: Product Tree Element code

nnn: Sequence number that will be automatically generated by the application

The user must define:

- The character to be used as separator inside the Configuration change code. In this example and along this manual, we have selected the "/". The only character not allowed is the "%".
- The Configuration change identifier which could be any combination of alphanumeric characters (excluding "%"). In this manual, we have used the acronym CC (Configuration Change).
- The order of the different parts of the Code. It means that all these combinations are possible: CC/PT/nnn, CC/nnn/PT, PT/nnn/CC, nnn/CC/PT, nnn/PT/CC and PT/CC/nnn.

- **Non-conformities**: The No-conformities follow the pattern described below:

NC/PT/nnn

where,

/: Non-conformities separator

NC: No-conformity identifier

PT: Product Tree Element code

nnn: Sequence number that will be automatically generated by the application

The user must define:

- The character to be used as separator inside the Non-conformity code. In this example and along this manual, we have selected the "/". The only character not allowed is "%".
- The Non-conformity identifier which could be any combination of alphanumeric characters (excluding "%"). In this manual, we have used the acronym NC (No-conformity).
- The order of the different parts of the Code. It means that all these combinations are possible: NC/PT/nnn, NC/nnn/PT, PT/nnn/NC, nnn/NC/PT, nnn/PT/NC and PT/NC/nnn.

- **Anomalies**: The Anomalies follow the pattern described below:

AN/PT/nnn

where,

/: Anomalies separator

AN: Anomaly identifier

PT: Product Tree Element code

nnn: Sequence number that will be automatically generated by the application

The user must define:

- The character to be used as separator inside the Anomaly code. In this example and along this manual, we have selected the "/". The only character not allowed is "%".
- The Anomaly identifier which could be any combination of alphanumeric characters (excluding "%"). In this manual, we have used the acronym AN (Anomaly).
- The order of the different parts of the Code. It means that all these combinations are possible: AN/PT/nnn, AN/nnn/PT, PT/nnn/AN, nnn/AN/PT, nnn/PT/AN and PT/AN/nnn.