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E. Gorskaya, V. Samoilov, A. Raimondo*, A. Rijllart*

A COMPUTER-AIDED CONTROL SYSTEM FOR AUTOMATIC PERFORMANCE MEASUREMENTS ON THE **LHC** SERIES DIPOLES

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*CERN, Geneva

1. INTRODUCTION

The ***Test Master*** (TEMA) software is a part of the SM18 Test Benches management software system evolving at LHC/IAS. Using this programme, different magnetic measurement operations can be defined and performed in the ***test cluster*** installations in SM18 Hall. Each test cluster consists of two ***test benches*** with electronic and cryogenic systems. The TEMA is installed in a main workstation called the ***master workstation***. Each cluster has one master workstation and is connected to the ***slave workstations*** through a network. These slave workstations are assigned to the test benches of the cluster.

1.1 OVERVIEW OF TEST MASTER

In order to get an overall view of the TEMA, its main features from the user's point of view are described below:

- Using TEMA, hardware systems such as ***slave workstations***, ***power converter, HF acquisition, LF acquisition*** etc., can be selected according to the type of measurement (like ***MMP***, ***Power***, ***Loss*** and ***T-Coil***). This process is called ***configuration***. After configuration, the integrity of the hardware chosen in the configuration and the communication lines between them can be tested using ***Check Communication***.
- Sequence of commands can be organized by choosing from Pre-defined commands for each selected hardware system using ***Command Editor*** and stored in a file with an extension ****.cmd.***
- Combination of Configuration information and sequence of commands for all the hardware chosen in the configuration is defined as ***Test*** and stored in a file with an extension ****.tst***.
- Using ***Sequence Editor***, sequence of tests can be organised by choosing from the already defined Tests. The sequence of tests is stored in files with an extension ****. Seq.*** The stored test sequence is called ***Measurement Cycle*** or ***Application***.
- The measurement cycle can be communicated to the slave workstations using ***Run Sequence***. Then the measurement cycle becomes resident in the slave workstation and will be executed automatically.
- This execution of measurement cycle will control the hardware and software components of the test bench connected to the slave workstations in an appropriate manner to carry out the magnetic measurement.
- Interrupts can be sent to ***abort*** the measurement cycle in execution.
- TEMA will automatically receive ***status*** information from the slaves for controlling and monitoring the measurement cycle. The TEMA also records the information about every operation in a separate ***log file*** for future review.
- There are three different levels of authorizations available in TEMA. They are ***Operator***, ***Expert*** and ***Manager*** levels. Authorization can be assigned to the users at any levels. The

TEMA allows the user to perform operations depending upon the user-level assigned to them.

- Path can be assigned or modified for the different files used by the TEMA by ***path configuration.*** Slave workstations can be added or removed using ***configure slave workstations.***
- Cluster ID, Cluster Name, Bench ID and Bench names can be assigned or modified using ***Edit Cluster***. All the configuration changes can be updated using ***Update files***.

1.2 FUNCTIONS OF THE TEST MASTER

The Test Master is used to define, control and monitor all the magnetic measurement operations to be performed in a test cluster, which consists of two test benches. This can be done from the *master workstation*, where the Test Master is running. A predetermined measurement cycle is defined in the Test Master for this purpose. Then the measurement cycle can be communicated to the *slave workstations* assigned to cluster operation. The communicated measurement cycle becomes resident on the *slave workstation* and is executed automatically. This will control different applications running on the *slave workstation* in an appropriate manner to carry out a particular magnetic measurement process. The Test Master also sends interrupts to abort the measurement cycle in execution and also receives different types of status information for monitoring and control. The measurement cycle consists of a test of commands and hardware configuration or a sequence of tests. Test Master has three levels of operation as given below:

The Operator level is the lowest level. At this level of operation, the Test Master allows the user to check the communications between *master workstation* and *slave workstations*, updates reference information about the configuration files in slave workstations and executes an already defined test or a sequence of tests.

The Expert level is the middle level. At this level of operation the user can create new tests or edit existing tests, build and modify the sequences of tests. This level can also perform Operator level functions.

The Manager level is the highest level. At this level the user can select the slave workstations of the cluster, that will be controlled. Also he can get the names of the configurations files present in slave workstations. In addition, the user can change the path configurations, the Bench allocation and cluster information. This level also can perform Expert level operations.

2. TEST MASTER FROM OUTSIDE

2.1 STRUCTURE OF TEST MASTER

The structure of TEMA software is organized in following four modules:

- ***Install*** module

- ***Define Test*** module
- ***Build Sequence*** module
- ***Run Sequence*** module

These modules can be viewed as different modes of operations. Level of authorization needed and different operations possible in each mode are described bellow.

2.1.1 INSTALL MODE

Manager level authorization is needed to use this mode and the following operations can be performed in this mode:

- Change ***path configuration*** of different files used by the TEMA
- ***Configure slave workstations*** assigned to different test benches
- ***Check communications*** between slave and master workstations
- ***Edit Cluster*** information
- ***Configure the users*** with assigned user level and password
- ***Update*** the information about configuration files of applications
- Take over ***Force control*** of another master workstation

2.1.2 DEFINE TEST MODE

Manager or Expert level authorization is needed to use this mode and the following operations can be performed in this mode:

- ***Modify*** existing tests
- ***Add*** and ***build*** new tests
- ***Delete*** tests

2.1.3 BUILD SEQUENCE MODE

Manage, Expert or Operator level authorization is needed to use this mode and the following operations can be performed in this mode:

- ***Modify*** existing sequence of tests
- ***Add*** and ***build*** new sequence of tests
- ***Delete*** sequence of tests
- ***Check application*** before executing the sequence of tests
- ***Load application*** remotely

2.1.4 RUN SEQUENCE MODE

In this mode the following operations can be performed at all levels of operators.

- ***Check application*** before executing and communication between hardware
- ***Load applications*** remotely
- ***Edit Magnet*** Name

- ***Run*** a sequence of tests or a single test and ***Monitor***
- ***Abort*** the execution of measurement cycle

2.2 DISPLAY PANELS OF TEST MASTER

Every mode has a corresponding ***Synoptic*** panel display. The Test Master will always be operated through these panels. In general, icons and buttons are assigned to different operations in each panel. By clicking the mouse on them, sub-panels relevant to the operations will be opened for the user to interact. The general layout of the Synoptic panel display can be understood easily by observing the main panel displays shown in Fig. 1, 2, 3 and 4.

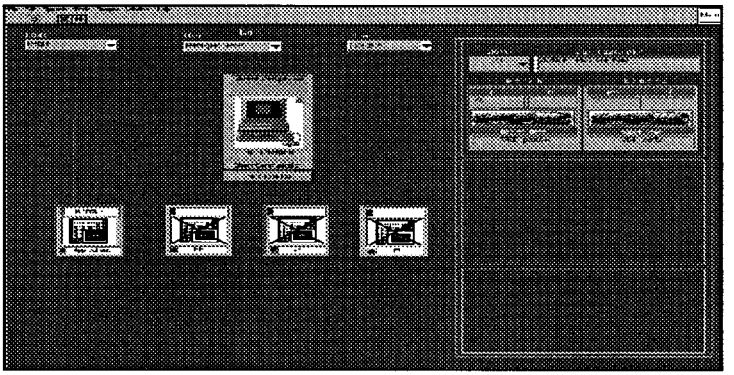

Fig. 1 Install Mode panel

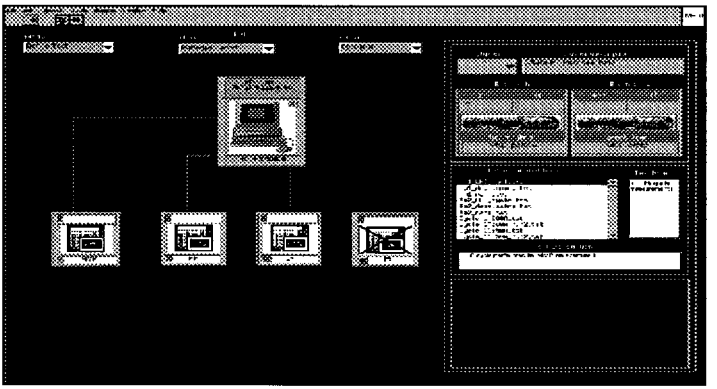

Fig.2. Define Test Mode panel

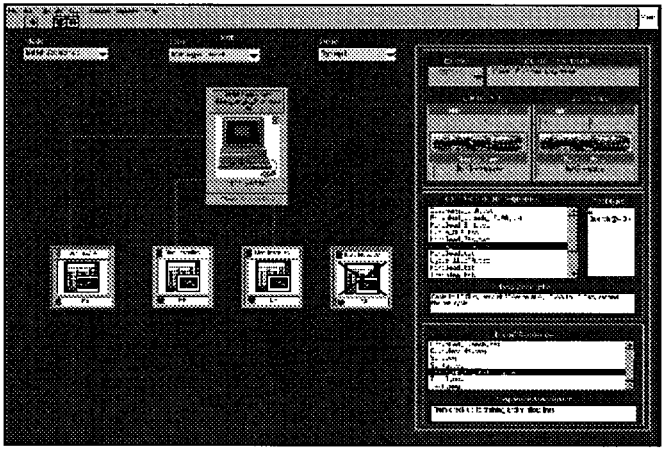

Fig. 3. Build Sequence Mode panel

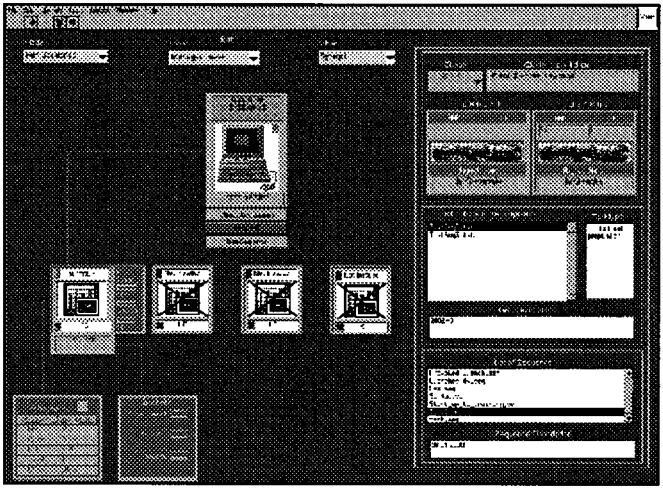

Fig. 4. Run Sequence Mode panel

In order to explain the display panel clearly, it is divided into three portions as (a) Top line, (b) Center Portion and (c) Right hand side.

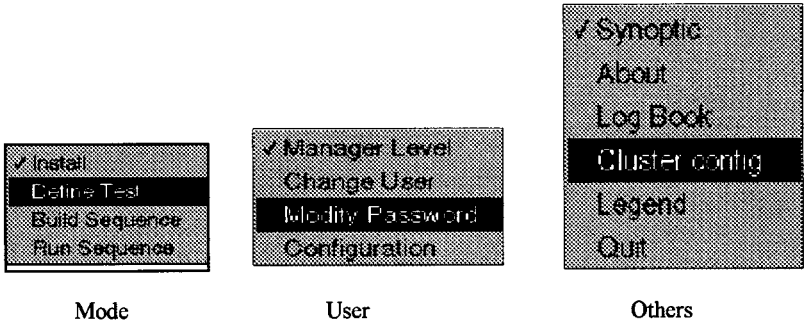

Fig. 5. Buttons available in three selection windows of the TEMA panel

2.2.1 TOP LINE OF THE PANEL

In the top line of all main panel displays, three selection windows with different buttons are available. They are indicated in Fig 5. Names of operations that can be performed for each selection window are described below.

Mode window.

Using the buttons available in ***Mode*** selection window, user can switch over from one mode of operation to another.

User window.

From this window, the following operations are available for the Operator or Expert level users.

- Login to TEMA using ***change user*** button.
- Change the password assigned to them by using ***modify password*** button.

In addition to those listed above, the following operations are available for the Manager level users:

- Remove or include users of TEMA, assign user level and password, and configure the operations allowed to different user levels using ***configuration*** button.

Others window.

From this window, the following operations are available for Operator or Expert level users:

- View the configuration of clusters using ***cluster configuration*** button.
- View the entries of log book using ***log book*** button.
- Get information about the TEMA using ***about*** button.

- View the meaning of the legends used in the display panels by using ***legend*** button.
- Exit from the TEMA programme using ***quit*** button.

In addition to those listed above, the following operations are also available for Manager level users:

- Alter the cluster configuration using ***cluster config*** switch.
- Enable or disable the logbook storage using an ***on/off*** switch available in the logbook display.

2.2.2 MIDDLE PORTION OF THE PANEL

In the middle portion of all display panels, the icons corresponding to the master workstation, slave workstation and other hardwares will be displayed. By clicking the mouse on the master icon (with a name ***Test Master***) of the display panel, different sub panels can be initiated. The names of the sub panels with corresponding main display panels are listed below:

- In Install Mode – ***Path configuration sub panel***
- In Define Test Mode – ***Define test sub panel***
- In Build Sequence – ***Sequence editor sub panel***
- In Run Sequence – operation is not defined

Just below the Master icon of each main panel, one or more buttons are available to initiate some of the TEMA operations. Names of these buttons and corresponding main display panels are listed below:

- In Install Mode – ***Check communication, File Update*** and ***Force control***
- In Define Test Mode – operation is not defined
- In Build Sequence Mode – ***Check application***
- In Run Sequence Mode – ***Check application, Run test*** and ***Run sequence***

In Define Test Mode, clicking the mouse on the slave icon or hardware icons will initiate the ***application parameter sub panel***. Using this, the following operations can be performed:

- Including or excluding the selected hardware in the test using ***activate on/off*** switch
- Create, modify or delete command files for the selected hardware using ***command editor***
- Assign ***name*** for ***application*** and ***command file.***

2.2.3 RIGHT HAND SIDE OF THE PANEL

On the right hand side of each main display panel different selection windows will be displayed.

In Install Mode:

Cluster selection window will be displayed. Using this, the TEMA can be assigned to the selected cluster. The ***name***, ***description***, its ***bench ID*** and the ***magnet names*** of the selected cluster will be displayed in the appropriate display windows.

In Define Test Mode:

Test selection window will be displayed. It contains the name ***list of defined test***. Test can be selected and loaded to TEMA by selecting it from the list. The test type and its description of the selected test will be displayed in the appropriate display window description. Using both ***test editor sub panel*** and ***command editor*** available in ***application parameter sub panel***, user can modify the loaded test.

In Build Sequence Mode and Run Sequence Mode:

Sequence selection window will be displayed. It contains the ***list of defined sequence***. Sequence can be selected and loaded to TEMA by selecting it from the list. The description, list of tests and test type of the selected sequence will be displayed in the appropriate display window. In Run Sequence Mode a single test or sequence of tests (measurement cycle) can be loaded by selecting it from the corresponding list and executed using ***run test*** or ***run sequence*** button. In Run Sequence Mode, the measurement cycle can be sent to the bench 1 or bench 2 by clicking on the corresponding bench icon.

2.2.4 LEGEND AND THE COLOR CODES

Colored lines connecting master icon to different slave icons and slave icons to hardware icons indicate the communication between master workstation, slave workstation and other hardware (fig. 6). User can obtain the status of the communication path visually from the color of these lines. For example, when hardware configuration is loaded for the first time or any change is made in the hardware configuration, the communication lines show red color. After initiating the check communication function the color of the line will turn to green if the communication is established.

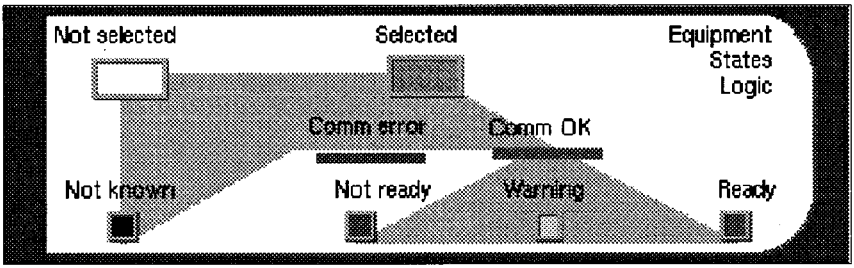

Fig. 6. Legend and color codes

If there is no communication, then the lines will remain red. In the right hand side of the synoptic panel, user can find the cluster information and the information of defined tests, measurements or test sequences relevant to the panel. Each icons displayed in the panel has a square shaped status indicator box. User can get information about the device status of the hardware visually from the color of these status indicator boxes. A window indicating color

codes and legends as shown in Fig.6 can be obtained by initiating the ***legend*** button of ***Others*** window.

2.3 LAUNCHING THE TEST MASTER

To launch the TEMA from the master workstation, the user has to perform the following operations:

- Type "**tema**" at the ***Xterm window prompt*** and press ***return***.
- Then the TEMA ***login window*** as shown in Fig.7 will be displayed.

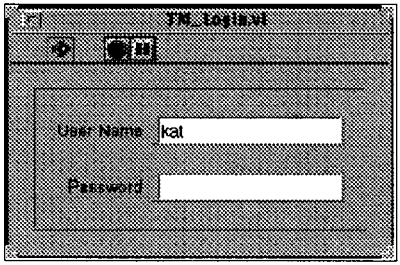

Fig.7. Login window of the TEMA

- Now the user has to type his **User Name** and **Password** and then click the ***confirm*** button.
- The TEMA now opens one of its synoptic panels depending on the privilege assigned to them.

User level and the corresponding synoptic panel first opened by TEMA after launching and the other allowed synoptic panels are tabulated below.

Level	First synoptic panel	Other allowed panels
Manager	Install mode	Define test, Build sequence & Run sequence
Expert	Define Test mode	Build sequence and Run sequence
Operator	Run sequence mode	

Thus, for users having Manager level privileges, all four synoptic panels of the TEMA will be available. They can switch to any one of the synoptic panel and start operating the TEMA depending on the requirement.

Expert privileged users *are* not permitted to any installations. So, excluding the install mode panel, only three panels are available to them. They can switch to any one of the three synoptic panels and start operating the TEMA depending on the requirement.

Operator level users are permitted to use only the Run Sequence mode. So they cannot switch over to any other modes.

2.4 INSTALL MODE FOR MANAGER LEVEL USERS

In this mode users having Manager level permission, can perform the following installation operations:

- Configure the users with assigned user level and password.
- Change path configuration of different files used by the TEMA.
- Check communications between slave workstations and master workstations
- Update configuration file information
- Edit Cluster Information.

2.4.1 CONFIGURING THE USERS WITH USER LEVEL AND PASSWORD

From the install mode, by clicking on the ***configuration*** switch of the user window, ***user configuration sub panel*** as shown in Fig. 8 will be opened. This subpanel consists of list of user names with level of operation and six buttons.

From this subpanel, Manager level user can perform the following operations:

- Include new user with some login ID and password using ***new user*** button
- Change the user level of the existing user by using ***change user*** button
- View the password of the other user by using ***show password*** button
- Remove the user from TEMA by using ***remove user*** button
- Modify the operation assigned to each user level using ***change permission*** button
- Exit from the user configuration panel using ***return*** button

2.4.2 CHANGING PATH CONFIGURATIONS

To change ***name*** and ***path configuration*** of different files used by the TEMA, the Manager level user has to click on the ***Test master*** button just below the master workstation icon. This operation will open the path configuration sub-panel as shown in Fig. 10. In this panel the user can modify path or name of the files. After the change the user can exit the path configuration panel by clicking on the **save and return** button or **cancel** button.

2.4.3 CHANGING THE CLUSTER ID AND CHECK COMMUNICATION

In Install mode main panel, user can find a cluster ID selection button. By clicking on this button user can find a list of available clusters as shown in Fig. 9. After selecting any one of the clusters, icons of different slave workstations of the selected cluster, which is connected to the master workstation, will be displayed in the main panel. The communication path between the

master and slave is also will be displayed in the main panel. For checking the communication to slave workstation, the user has to click on the check communication button located just below the master workstation icon. The colored lines connecting the workstation icon to master icon will show the communication status. The following logic is used to indicate different status. Absence of lines indicates that the slave is not physically connected to the master. If the lines are red and blinking, it indicates that both communication not established and also slave is not ready. If the lines are red, the communication is established, but the slave workstations are offline or not ready. Green lines indicate that communication is established and workstation is also ready. The small square box (upper LED) in the slave workstation icon also indicates ready status.

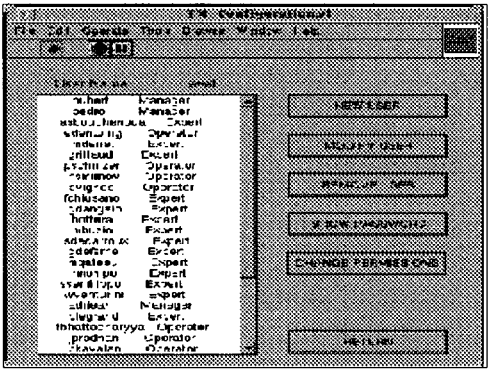

Fig.8. User configuration sub-panel

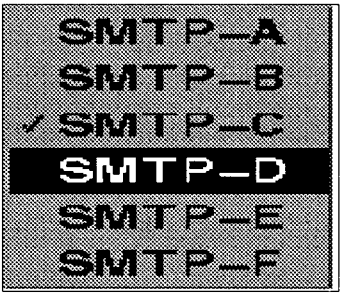

Fig. 9. List of test clusters that can be connected to the TEMA

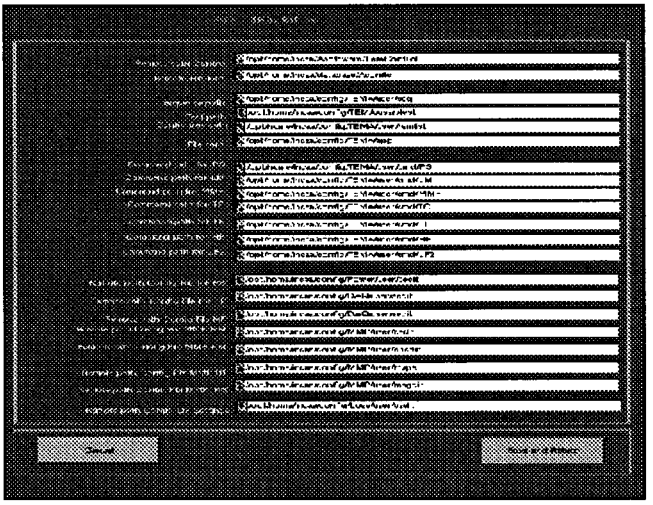

Fig.10. Sub-Panel for changing path configuration

2.4.4 SETTING AND UPDATING THE CLUSTER CONFIGURATION

In the install mode main panel, from the window titled ***"Others"***, user can find ***cluster configuration*** button. By clicking the mouse on this button cluster configuration subpanel can be opened as shown in Fig. 11. In this sub panel, user can set the *Cluster ID and Bench ID by* typing the appropriate name in the *Cluster ID and bench ID* fields respectively. In similar way user can write the cluster description in the *Cluster Description* field.

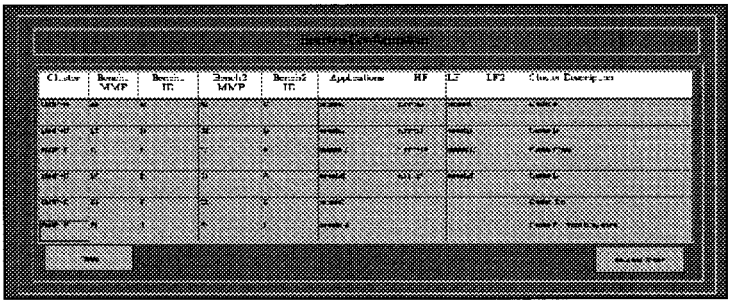

Fig. 11. Cluster configuration sub-panel

After the cluster configuration user can exit from the subpanel either by clicking on the ***save*** and ***return*** button or ***cancel*** button.

Finally, after the cluster configuration change, it is important to update the configuration information in the TEMA programme. User can do this update by clicking on the **file update** button shown below the master icon of the main panel.

2.4.5 FORCING THE CONTROL OF A CLUSTER

Normally, the applications and measurement cycles running in slave workstations of a particular cluster are controlled from the master workstation allocated for that cluster. The manager level user can override this allocation by forcibly taking the control of any slave workstation or cluster from any master workstation on which he is currently working. This operation can be done using the Force control button available below the master icon.

2.5 DEFINE TEST MODE FOR MANAGER AND EXPERT LEVEL USERS

The Define test mode panel can be initiated by clicking ***define test*** button in the Mode window. In this mode users having Manager level or Expert level permission, can perform the following operations:

- Loading the pre defined test from the list of tests
- Delete the predefined test from the list of tests
- Modify the predefined test and update in the list of tests
- Define new test and add to the list.

2.5.1 LOADING THE PREDEFINED TEST FROM THE LIST OF TESTS

This operation can be done from the main panel itself. User can find the list of defined tests displayed on the right hand side of the main panel. In order to load the predefined test user has to do the following operation:

- Select the name of the test from the test list.
- Click the mouse on the selected name.

These operations will load the selected test, which means loading the hardware configuration and the corresponding command file information of the selected test. The loaded hardware configuration can be easily identified by the appearance of the communication line between the hardware icons and master icon. The name of the loaded test will also appear at the master icon of the main panel.

2.5.2 DELETING A PREDEFINED TEST FROM THE LIST

To delete the predefined test, it should be loaded first as described in the previous section. Then the loaded test can be deleted using the test editor subpanel as follows: Initiate test editor subpanel by clicking the master icon of the main panel. Test edit subpanel will appear in the screen as shown in the Fig.12:

- Check the name of the test displayed in the Test Name-in window.

- Check the description of the test in the Test description window.
- Make sure that the loaded test is the one you want to be deleted.
- Click the mouse on ***delete this test*** button.
- Confirmation window will appear. Confirm by clicking the mouse on ***yes*** button.
- Click the mouse on ***update*** and ***exit*** button.

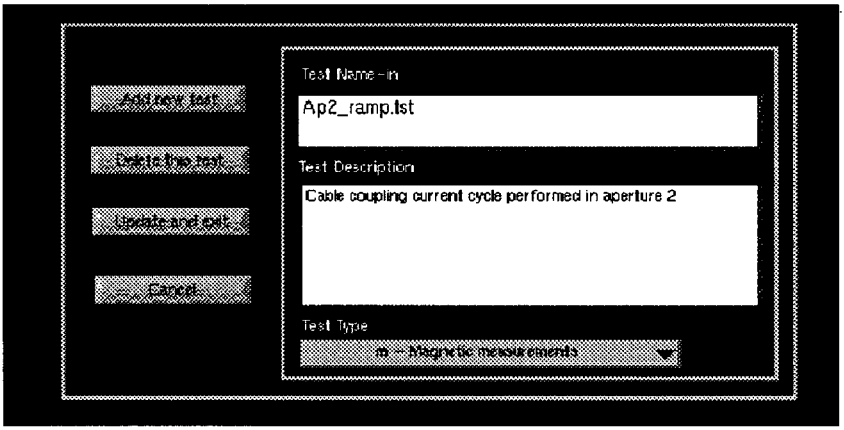

Fig. 12. Test Editor sub panel

2.5.3 MODIFYING A PREDEFINED TEST AND UPDATING THE LIST

In order to modify the predefined test, it has to be loaded as described before. Then the following steps of operations have to be performed.

Step 1. Modification of hardware components:

- Click the mouse on the icon (displayed in the main panel) corresponding to the hardware to be added, removed or modified.
- This operation will initiate the corresponding application parameter sub panel for the selected hardware as shown in Fig.13. The name of the command file, which contains the sequence of defined commands, will also appear in the command file field of the sub panel. In the application parameter sub panel the user can perform any one of the following operation depending on the requirement.

Step 2. Modification of application parameters:

- If the selected hardware has to be removed then the user can switch off the activate-switch by clicking the mouse on it and exit from the application parameter sub panel.

- If the selected hardware has to be retained and only its sequence of commands has to be modified then the user leaves the activate switch unaltered and stay in the application parameter subpanel.
- If the selected hardware is a new one to be added to the test, then the user can add it by switching on the activate switch of the application parameter sub panel.
- If the existing command type of the test has to be changed then the user can change it by selecting it from the window named **Applications**.

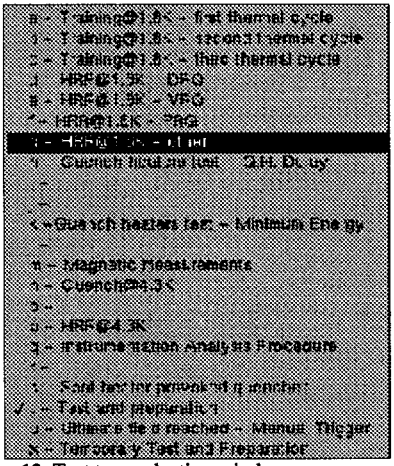

Fig. 13. Test type selection window

Step 3. Editing the command sequence using command editor:

- Now the user can initiate the command editor by clicking the mouse on the ***Edit command file*** button.
- This operation will initiate the command editor subpanel. The layout of the command editor subpanel can be understood from Fig. 16. It consists of four windows, four buttons for editing, two buttons for saving and one button for quit without saving (cancel).
- In the first window named **list of command**, all possible commands available for the command type selected are displayed. User can select a command from the list by clicking the mouse on its name. The selected command will appear in the command field of the second window.

- If the ***edit command file*** button is initiated from the sub panel of hardware, which is already defined in the loaded test, then sequence of command will be displayed in the fourth window named **sequence of command**.
- If the command requires any file for its operation, the command editor automatically prompts the user by opening a File name field in the second window. Also list of default files will be displayed in the third window.
- User can now select an appropriate file by clicking the mouse on its name. The selected name will appear in the File name field of the second window. Alternatively, file not in the list can also be directly typed in the File name field of the second window.
- Similarly, if the selected command needs any parameters or hardware settings, appropriate field or selection windows will be opened in the second window. User has to type the required parameter in that field or select from the options displayed.
- Then the selected command can be added to the sequence by clicking the mouse on the appropriate buttons named ***add command after*** and ***add command before***. Then the name of the selected command will appear in the fourth window named **sequence of command**.
- The command added to the sequence can also be replaced or deleted using the buttons named ***replace command*** and ***delete command*** respectively. Before initiating these operations user has to select the command to be replaced or deleted in the fourth window by clicking the mouse on it.
- After completing the command sequence, user can save it in a file by clicking the mouse on the ***save as*** button of the command editor and by assigning a name with an extension (*.cmd). After saving the file, the command editor sub panel will be automatically closed and the saved command sequence File name will appear in the command file name field of the Application parameter sub panel. Then user has to close the application parameter panel by clicking the mouse on the ***save and return*** button.
- User has to repeat this step 2 and step 3 for other hardware component needed modification.

Step 4. Saving the Edited test using the test editor:

- Initiate test editor subpanel again by clicking the master icon of the main panel. Click the mouse on the ***update*** and ***exit*** button. This operation will save the modified hardware configuration and the edited sequence of command file information in the same test.

2.5.4 DEFINING A NEW TEST AND ADDING IT TO THE LIST

In order to define a new test and add it to the list, user has to do the following steps of operations. The operation can be divided into following steps.

Step 1. Assigning a name, description and type to the test to be defined and added to the test list:

- Initiate test editor sub-panel by clicking the master icon of the main panel. Test edit sub panel will appear in the screen as shown in the Fig.12.
- Click the mouse on the button named ***add new list***.
- Assign a name for the test by typing the name in the Test Name-in window.
- Type some description for the test to be defined in the Test description window.
- Choose the test type from the **test type** window shown in the Fig.13 This window can be initiated by clicking on the ***test type*** button of the test editor sub panel.
- Click the mouse on the button named ***update and exit***.
- The above operation will create a file with the assigned name and extension (*.tst).

Step 2. Select the newly added test from the test list:

- Search for the newly created test name in the test list box and click the mouse on the name listed in the test list box.

Step 3. Add the necessary hardware components (applications), command type and creating command sequence using command editor:

- Click the mouse on the icon of the hardware (application) to be added. This operation will initiate the corresponding application parameter sub panel for the selected hardware (applications) as shown in Fig.14.

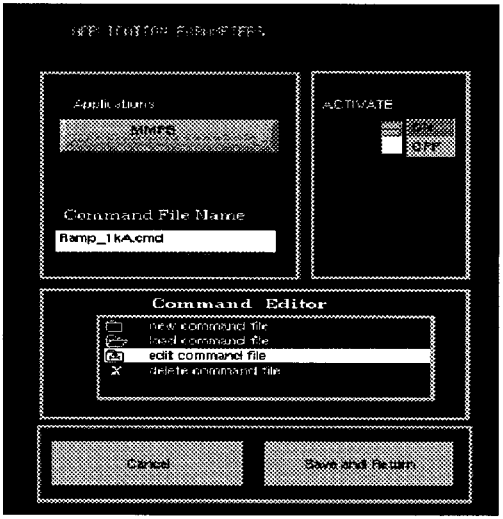

Fig. 14. Application parameter subpanel

- Switch on the activate-switch of the application parameter sub panel by clicking the mouse on it.
- Select the type of commands to be added by selecting it from the window named **applications**. Different options available in this window are shown in Fig. 15.
- Initiate the command editor by clicking the mouse on the ***new command file*** button. This operation will initiate the command editor sub panel as shown in Fig. 16.

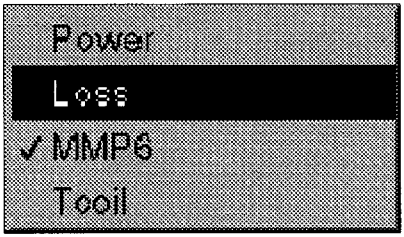

Fig.15. Application type selections

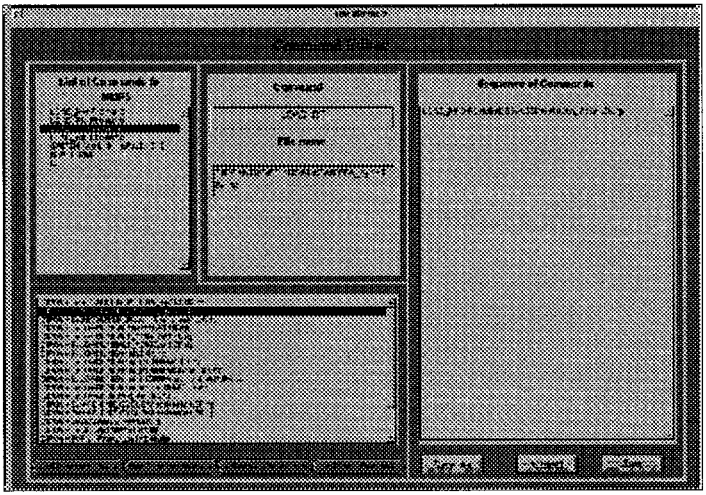

Fig. 16. Command editor sub panel

- The layout of the command editor sub panel can be understood form Fig. 13. It is divided into four windows.
- In the first window a list of command for the selected command type is displayed. User can select a command from the list by clicking the mouse on its name. The selected command will appear in the command field of the second window.
- If the command requires any file for its operation, the command editor automatically prompts the user by opening a File name field in the second window. Also list of default files will be displayed in the third window.
- User can now select an appropriate file by clicking the mouse on its name. The selected name will appear in the File name field of the second window. Alternatively, file not in the list can also be directly typed in the File name field of the second window.
- Similarly, if the selected command needs any parameters or hardware settings, appropriate field or selection windows will be opened in the second window. User has to type the required parameter in that field or select from the options displayed.
- Then the selected command can be added to the sequence by clicking the mouse on the appropriate buttons named ***add command after*** and ***add command before***.
- The command added to the sequence can also be replaced or deleted using the buttons named ***replace command*** and ***delete command*** respectively. Before initiating these operations user has to select the command to be replaced or deleted in the fourth window by clicking the mouse on it.
- After completing the command sequence, user can save it in a file by clicking the mouse on the ***save as*** button of the command editor and by assigning a name with an extension (*.cmd). After saving the file the command editor subpanel will be automatically closed and the saved command sequence file name will appear in the command file name field of the Application parameter subpanel. Then user has to close the application parameter panel by clicking the mouse on the ***save and return*** button.
- User has to repeat this step 3 for other hardware components needed for the test to be defined.

Step 4. Saving the created test using the test editor again:

- Initiate test editor subpanel again by clicking the master icon of the main panel. Click the mouse on the ***update and exit*** button. This operation will save the activated hardware configuration and the corresponding sequence of command file information in a file with the assigned name and extension (*.tst) created in the step 1.

2.6 BUILD SEQUENCE MODE FOR MANAGER & EXPERT USERS

The Build Sequence mode panel can be initiated by clicking the ***build sequence*** button in the Mode window. In this mode users having Manager and Expert level privilege, can perform the following operations:

- Loading the predefined sequence of test from the list of sequence.
- Delete the predefined sequence of test from the list of sequence.

- Modify the predefined test and update in the list of sequence.
- Build a new sequence of test and add it to the list of sequence.

2.6.1 LOADING THE PREDEFINED SEQUENCE

This operation can be done from the main panel itself. User can find the list of predefined sequence displayed in the right hand side of the main panel. In order to load the predefined sequence user has to do the following operation:

- Select the name of the predefined sequence from the sequence list
- Click the mouse on the selected name.

These operations will load the selected sequence, which means preparing to load the test arranged in the sequence one by one.

2.6.2 DELETING THE PREDEFINED SEQUENCE FROM SEQUENCE LIST

To delete the predefined sequence of test, this sequence should be loaded first as described in the previous section. Then the loaded test can be deleted using the sequence editor subpanel as follows: Initiate the sequence editor subpanel by clicking the master icon of the main panel. The sequence editor subpanel will appear in the screen as shown in the Fig.17:

- Check the name of the test displayed in the **Name sequence** window
- Check the description of the test in the **Sequence description** window
- Make sure that the loaded sequence is the one you want to be deleted.
- Click the mouse on ***delete this sequence*** button.
- Confirmation window will appear. Confirm by clicking the mouse on ***yes*** button.
- Click the mouse on ***update and exit*** button.

2.6.3 MODIFYING AND UPDATING THE PREDEFINED SEQUENCE

In order to modify the predefined sequence, it should be loaded first as described before. Then the following set of operations has to be performed.

Step1:

Initiate the ***sequence editor sub panel*** by clicking the mouse on the master icon (named ***Test master***) of the ***Build Sequence mode*** panel.

The layout of this panel is shown in Fig. 17. In the top line of the sub panel user can find two buttons named ***add new sequence*** and ***delete this sequence***. Below this top line **Name sequence** and **Sequence description** windows will be displayed. Below this windows two windows named **List of defined test** and **List of selected tests** separated by five buttons named ***add test before***, ***add test after***, ***delete from sequence***, ***update and exit*** and ***cancel*** will be available.

If the user is initiating the sequence editor sub panel after loading the sequence from the main panel, the name, its ***description*** and ***list of test*** available in the sequence will be displayed in the **Name sequence** window, **Sequence description** window and **List of selected tests** window respectively.

Step2:

Now the user can edit the sequence of test displayed in the **List of selected tests** window in the following ways.

If the user wants to remove a test from the sequence then he can select it using mouse and click ***delete from the sequence*** button on the sub panel.

If the user wants to add a new test to the sequence, then he can select the test to be added to the list by clicking the mouse on its name in the **List of defined tests** window and transfer to the **List of selected tests** by using ***add test before***, ***add test after*** depending on the requirement.

Step3:

The user can save the modification by clicking the mouse on the ***update and exit*** button. In case the user doesn't want to update the changes he has made, he can come out of the subpanel without saving the modification by clicking the mouse on the ***cancel*** button.

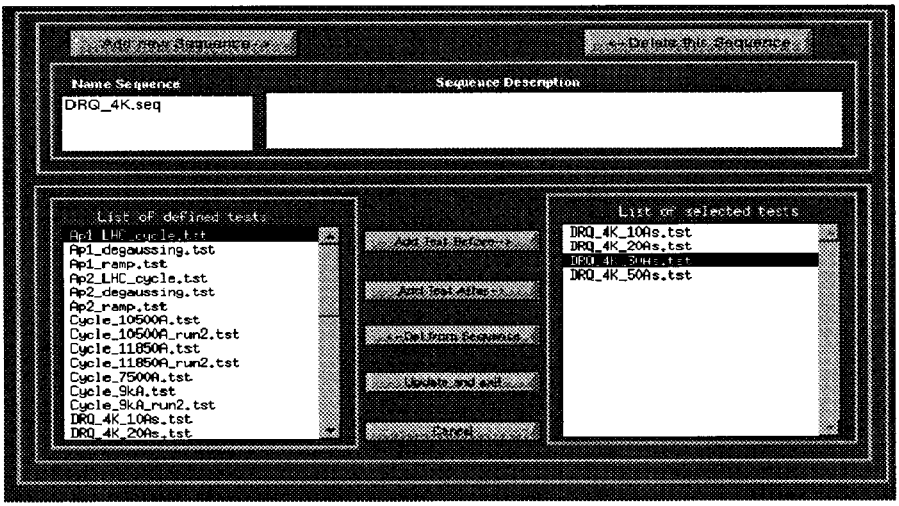

Fig.17. The sequence editor panel

2.6.4 DEFINING THE NEW TEST SEQUENCE

In order to define (or build) a test sequence, the following set of operations has to be performed.

Step 1:

Initiate the sequence editor sub panel by clicking the mouse on the master icon (named ***Test master***) of the Build Sequence mode panel

Step 2:

After initiating the sequence editor subpanel, click the mouse on ***add new sequence*** button. Then the **Name sequence** window, **Sequence description** window and the **List of selected test** window will be cleared.

Step 3:

Assign new name and write some descriptions for the sequence to be built

Step 4:

Select the name of the defined test to be added in the sequence from the list displayed in the **Defined test** window by clicking the mouse on the name.

Step 5:

Transfer the selected name to the **List of selected tests** window by using the ***add test before*** and ***add test after*** buttons depending upon the requirement. User can also delete the already added test from the **List of selected tests** window, by using ***delete from the sequence*** button.

Step 6:

After defining the test sequence user can save it by clicking the ***update and exit*** button or ***cancel*** button if the sequence built to be abounded.

The list of commands available in TEMA is shown in table 1 and 2; and the file conventions and type are listed in table 3.

2.7 RUN SEQUENCE MODE FOR ALL LEVEL USERS

The Run Sequence mode panel can be initiated by clicking Run Sequence button in the Mode window. In this mode users having Manager level, Expert or Operator level permission, can perform the following operations:

- Loading the predefined test of sequence of test from the appropriate list displayed in the right hand side of the main panel
- Changing the magnet name
- Checking the application and communication paths
- Executing the loaded test or sequence
- Monitoring the status of the running cycle

2.7.1 SELECTING THE SEQUENCE OF TEST AND CHANGING MAGNET NAME

From the Run Sequence mode the user can select a sequence of tests by clicking on the sequence name in ***List of Sequence*** box. After the selection, the list of test in the sequence will appear in the ***Measurement Sequence*** box. The hardware configuration and the communication paths of the selected sequence also will be displayed in the main panel.

If only an individual test of the selected sequence required to be selected, then the user can select it by clicking on the name of the test in the ***List of test*** box. The hardware configuration and the communication paths of the selected test will be displayed in the main panel.

User can also change Magnet name by typing new name in the ***Magnet Name*** field in the main panel if required.

2.7.2 CHECKING THE APPLICATION AND COMMUNICATION STATUS

User can check an applications status by clicking on the ***check application*** button. This operation will reload remotely the applications if they aren't alive. The user can also abort the operation by clicking on the ***abort check*** button displayed in the panel. If the checking is finished successfully without any error message, then the user can run one particular ***Test*** or execute a ***Sequence of Tests***.

2.7.3 EXECUTION OF SEQUENCE OF TESTS AND MONITORING

Before executing a sequence of tests, user has to set the execution which is to be done in test bench 1 or test bench 2 of the cluster. Clicking the mouse on the corresponding bench icon of the run sequence panel can do this selection. If the user wants to run a single test, which he has selected from the sequence earlier, then the user has to click on the ***run test*** button. If the user wants to run the entire sequence of tests, then the user has to click on the ***run sequence*** button. The execution can be aborted by clicking the ***abort sequence*** button displayed in the panel.

While executing of a test or a sequence of tests, user can follow the situation by monitoring the different icons of the remote applications hardware involved in the measurement (interlocks, cryo-status, active aperture status, temperature, Dipole current and others).

3. TEST MASTER FROM INSIDE

3.1 SOFTWARE DESCRIPTION

As already explained, the predefined measurement cycles are created using the Test Master, on the *master workstation*. In order to execute, monitor and control this predefined measurement cycle in the *slave workstations* allocated to the cluster, the Test Master program has several interfacing program components. These components are organized in the following three types of program layers:

- **User interface layer** that provides the operator facility. It is placed on the *master workstation.*
- **Monitor layer** that drives all the applications that will take part in testing on cluster. It is placed on the *master workstation* too.
- **Application layer** that drives an application on one of the *slave workstations*. Its program clones are placed together with the controlled applications on the *slave workstations* of the test cluster.

The overall structure of the Test Master and its different application layers and the communication paths between them is shown in Fig.18.

3.1.1 USER INTERFACE LAYER

Among the three layers, the **user interface layer** is the main panel of Test Master programme. The main panel has four modes for the different user levels. The detailed software structure for different mode of main panel is shown in Fig.19.

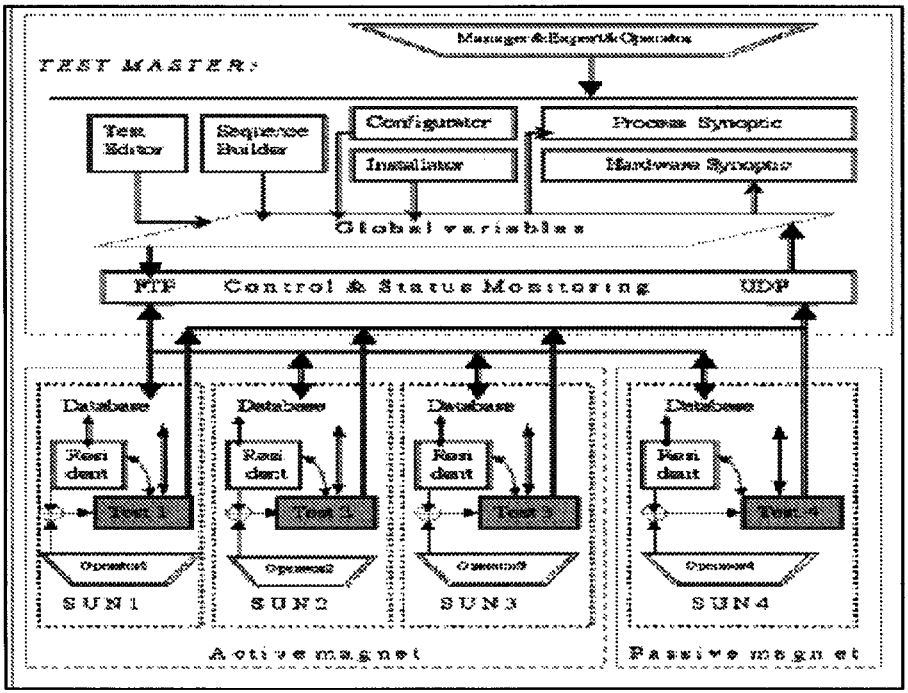

Fig. 18. The Test Master general structure and communications

Beside the main panel, this layer consists of seven panel-subroutine components. These seven components are listed below with a brief description:

- **Installer**: It is used in Install Mode. This program component is used for the installation and checking of the hardware and software before starting any measurements.
- **Configuration Builder**: It is used in Install Mode. This program component allows the user to configure the cluster's hardware and software for the forthcoming measurements. These configurations are stored in two files (CONFIGURATION, CONFIGURATION.dgr).
- **Command Editor**: It is used in Define Test Mode. This program component allows the user to create files of the Test Master command (*.cmd). These command files are defined for each application.

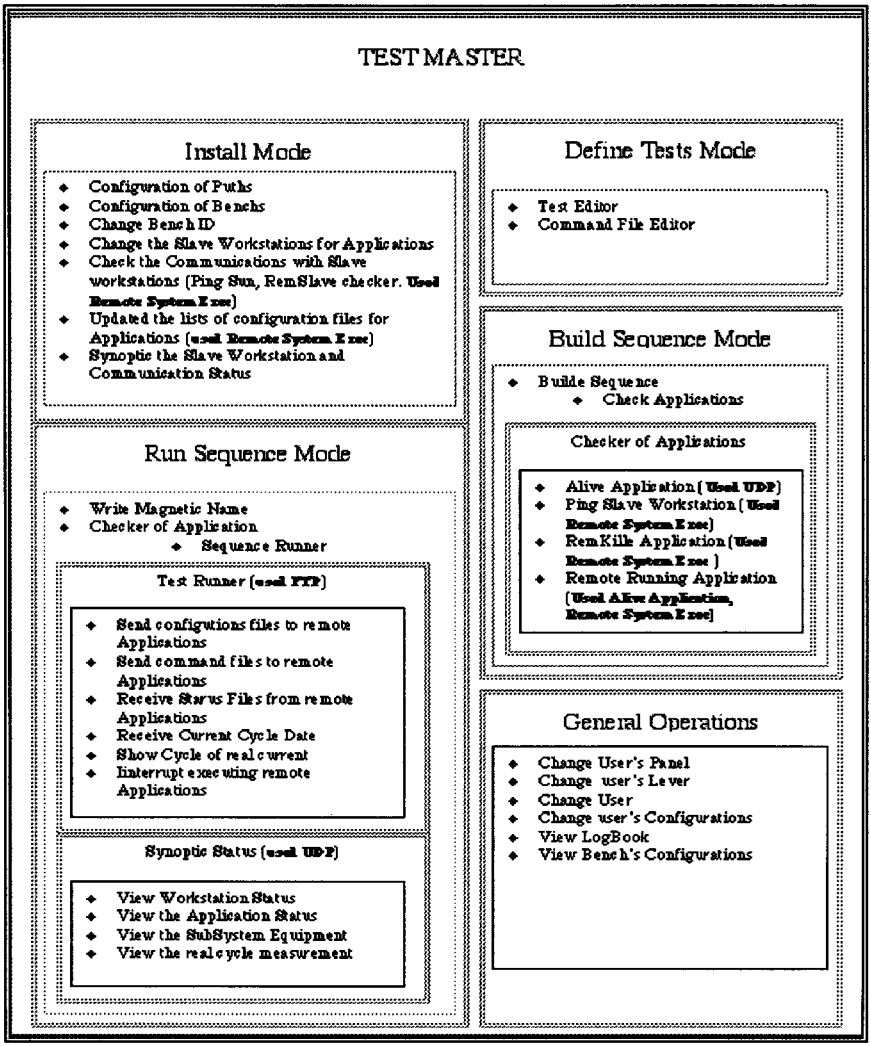

Fig. 19. The Test Master detail software structure

- **Test Editor**: It is used in Define Test Mode. This program component allows the user to create test files (*.dgr, *.tst). These Test files are composed of commands and/or configurations arranged in a sequence to perform a particular measurement in a cluster. Fig.18 shows the hierarchical design of the Test editor.
- **Sequence Builder**: It is used in Build Sequence Mode. This program component allows the user to define the series of measurements, which is called the Sequence of Tests. This is a composition of the tests, which can be executed one by one. Fig.18 shows the hierarchical design of the Sequence editor.
- **Process Synoptic**: It is used in Run Sequence Mode and in Build Sequence Mode for the process status indication. It displays the status of the applications and the steps performed during the execution of measurement cycle, which are running in the *slave workstations* of test cluster initiated by the Test Master.
- **Hardware Synoptic** : It is used in Run Sequence Mode for hardware status indication. It displays the current status of hardware objects of the cluster.

The global variables and data files are used for data exchange between this layer and Monitor Layer.

3.1.2 MONITOR LAYER

The next layer is the **Monitor Layer**. It is the realization of the communication protocol between the Test Master User's interface and all applications, running in the Applications layer. In other words, this layer is acting as an interface between the user interface layer and the application layer. In Fig.17 this layer is shown as **Control & Status Monitoring Layer**. This layer consists of two program components running in parallel to the Test Master main panel:

- **Control monitor**: This component receives the information about the user's actions on the Test Master's main panel over several global variable panels and file systems. The **Control Monitor** gets the information, treats it and sends corresponding commands to the applications of the connected *slave workstations*. For this purpose the **Control Monitor** uses the remote system command execution and the FTP functions. The remote system command is used for verifying the *slave workstations* (*Tmping.vi*), for checking and launching in parallel the needed applications (*Tmremps.vi, Tmremrun.vi*). The FTP functions are used for sending the command files *(*.cmd)*, interrupts files *(*.int)* and configuration files *(*.cfg)* to the remote applications. It is also used for getting the status files *(*.sts)* and extracting cycles *(Pscycle.out)* files from the remote applications (*Tmstart.vi*). Fig.18 shows the hierarchical design of the **Control Monitor.**
- **Status monitor**: All applications, which are on the current tests, send the information about hardware and software status as UDP – messages (*datagrams*) to the *master workstation*. **Status monitor** is the component that receives all datagrams (*RecvInfo.vi*), decodes the information (*Decode Buffer.vi*) and puts in global variables for further indication on synoptic panels by **Process Synoptic** and **Hardware Synoptic**.

3.1.3 APPLICATION LAYER

This layer is part of the Test Master, but will be placed in every test-application on the *slave workstation* and will control it. In fact, it is a resident Test Master in applications. The Test Master uses the start-up script *RemStart.ksh* (on *slave workstation*) and *Remote System Exec* for the running the application and the resident program components of Test Master together. Fig.20 shows the application layer software structure for driving one test-application. There are three resident processes namely:

- **Commander process**
- **Interrupter process**
- **Status Transmitter process**

Commander process will be activated when the **Control monitor** of monitor layer, using FTP, puts new *command file (*.cmd)* to the application. Then the commands will be executed sequentially from the command file. At the end of the execution of each command, the status information will be written in the *Status file* (*.sts). The **Control monitor,** using FTP, gets the status files, analyses it and puts in global variables for the **Process Synoptic**. The hierarchical design of the **Commander process** of **Test Master Resident** is shown in Fig.18.

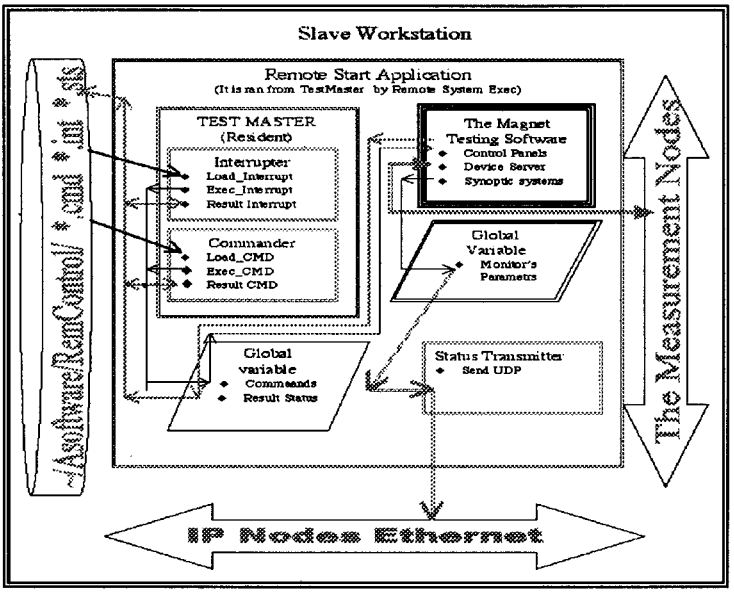

Fig. 20. The Application Layer software structure

Interrupter process will be activated when **Control monitor** of monitor layer, using FTP, puts the *Interrupt file (*.int)* for the application. The command sequence executing will be aborted then.

Status Transmitter process will be run in parallel with the application. It is activated every 3sec. It takes the current status information from the application, makes a datagram and transmits it, using UDP protocol, to the *master workstation* (for **Status monitor** and then for **Process Synoptic** and **Hardware Synoptic**).

3.2 THE COMMUNICATION PROTOCOLS

In order to communicate with and control the applications, which are run on *slave workstations*, the Test Master uses the following network protocol standards:

- The remote commands of Sun operating system
- The Transmission Control Protocol (TCP) Functions
- The User Datagrams Protocol (UDP) Functions

3.2.1 REMOTE SYSTEM COMMAND USING

The Test Master uses Labview System Exec.vi for executing commands on *slave workstations*. The network command *ping* is used for the configuration of *slave workstations* checking. The commands of Remote shell (*rsh*) are used for fast and parallel manipulation of the applications, which will be launched on the *slave workstations* of cluster. These are the commands:

- *Ps-* for the remote process status reporting
- *RemStart.ksh* - special script for remote applications starting
- *Kill* – for the not needed or bad remote process killing
- *Ls* – for the contents of remote directory listing
- *Cat SuperShare.cfg* – for the *slave workstation* identification

Besides the network command *g* is used for the *slave workstation* status checking.

3.2.2 THE FTP TOOLS USING

The Test Master uses the TCP protocol for the controlling applications when they are executing a test or a sequence of tests.

The **Control monitor** using FTP puts *command files* and *interrupt files* to the applications. Likewise it gets *status files* from the applications.

Initially every application can be used in a Stand Alone Mode, executing the manual Operator actions on **Control Panels**. But when the remote *command files (*.cmd)* are put by the

Control monitor (last modification date of the file was changed), the **Commander process** switches the application in **Remote Mode** (*Test Master controlled*) and sends the commands one by one (as global variable) to the application.

The application interprets every Test Master command as operator's actions on the **Control Panel**, executes them and sends the results to the **Commander process**. The **Commander process** writes the results in the status file (**.sts*) during the execution of command files. During this time the **Control monitor,** using FTP, gets the status file, analyses it and animates Synoptic Panels. Fig.9 shows the principle of interconnections between the resident of the Test Master and the test application.

The interrupt files (**.int*) are used for the command file execution abort. The **Interrupter process** will activate when the **Commander process** puts a new *interrupt file* (last modification date of the file was changed). It stops the executing command by actioning the ***abort*** button on working panels of the application. The **Commander process** interrupts the remaining commands.

3.2.3 THE USE OF UDP SOCKETS

The Test Master uses UDP for the processes and hardware monitoring during a test or a sequence of tests executing.

When the application runs, its **Status Transmitter** will send periodically UDP datagrams across the network to the Test Master. The datagrams contain information about processes and hardware status of this application.

Every time, when the Test Master is gone in Run Mode, it will activate the **Status monitor** of the **Monitor Layer**. The **Status monitor** will receive periodically UDP datagrams from all applications of cluster. The information from datagrams will be analysed and shown on the Test Master Synoptic Panels.

3.3 THE TEST MASTER FILE SYSTEM

The Test Master file system is a hierarchical file system that is placed partly on the *master workstation* and partly on the all *slave workstations* of a cluster.

3.3.1 THE FILE SYSTEM FOR THE TEST MASTER CONFIGURATION

The files for the Test Master layer are kept in a separate directory. The path of this directory is: *master workstation Name: /opt/home/incaa/config/TEMA/.*

The table 1 contains a list of files and files description. The directories are described in the grey rows and the files are described in the white rows.

Table 1. The Test Master layer files

Direction or File Name	Description	Write	Use
user/diagrams//	The files of the main panel objects status		
*.dgr *.txt	The files define the application objects status after loading <test Name >Test	Main panel after test changing	Main panel, by loading test
Users	The information about users	Main panel, by changing users configuration	Main panel by changing users
CONFIGURATON CONFIGURATON .dgr	The files define the *slave workstations* configuration	Main panel, after changing configuration	By loading Main panel
cmd/	All command files for all application		
user/HF/	The command files for the High Frequency	Test Editor	Control Monitor
user/LF/	The command files for the Low Frequency1	Test Editor	Control Monitor
user/LF2/	The command files for the Low Frequency2	Test Editor	Control Monitor
user/LM/	The command files for the Loss Measurement	Test Editor	Control Monitor
user/MMP/	The command files for the Magnetic Measurement	Test Editor	Control Monitor
user/PS/	The command files for the Loss Measurement.	Test Editor	Control Monitor
user/TS/	The command files for the Tcoil	Test Editor	Control Monitor
user/TMlog/	The Logbook's files	[logEditor. vi] All user's actions are registered there	For history overlook

Table 1. Continued

Direction or File Name	Description	Write	Use
user/remlist/	The files, which contain the lists of the configuration files for remote applications, which are running in this Test	Main panel, 'File Update' button	Command Editor
CF_LMCH	The file of list of the channel files for the Loss Measurement	Main panel [SAVE_Cffile.vi]	Command Editor
CF_LMCYC	The file of list of Cycle Setting files for the Loss Measurement.	Main panel [SAVE_Cffile.vi]	Command Editor
CF_LMdaq	The file of list of data acquisition files for the Loss Measurement.	Main panel [SAVE_Cffile.vi]	Command Editor
CF_LMMG	The file of list of magnet setting files for the Loss Measurement	Main panel [SAVE_Cffile.vi]	Command Editor
CF_PS	The file of list of cycle setting files for the Power Supply	Main panel [SAVE_Cffile.vi]	Command Editor
CF_HFdaq	The file of list of cycle setting files for the High Frequency	Main panel [SAVE_Cffile.vi]	Command Editor
CF_LFdaq	The file of the list of the cycle setting files for Low Frequency1	Main panel [SAVE_Cffile.vi]	Command Editor
CF_LFrdaq2	The file of the list of the cycle setting files for Low Frequency2	Main panel [SAVE_Cffile.vi]	Command Editor
CF_MMP6HM	The file of the list of the HM-setting files for the Magnetic Measurement	Main panel [SAVE_Cffile.vi]	Command Editor

Table 1. Continued

Direction or File Name	Description	Write	Use
CF_MMP6MS	The file of the list of the MS-setting files for the Magnetic Measurement	Main panel [SAVE_Cffile.vi]	Command Editor
CF_MMP6RM	The file of the list of the RM-setting files for the Magnetic Measurement	Main panel [SAVE_Cffile.vi]	Command Editor
CF_MMP6RT	The file of the list of the RT-setting files for the Magnetic Measurement	Main panel [SAVE_Cffile.vi]	Command Editor
user/seq/	The files of the sequence of the tests	Sequence Builder	Test Master for running sequence
user/test/	The files, which define the applications and command files for one test	Test Editor	Test Master for running Test
app/	The special files, which are used for the interplay with the application layer	Control monitor	Control monitor
messages.cod	The message codes for the logbook.	[MSG_Editor.vi]	MSG_Log Editor
ListRemcmd.txt	The list of all commands of all applications	[TMmakeListsCMD.vi]	Command Editor
BenchMMP	The file contains the configuration of all benches	Configuration Builder	Installator
DeviceServer.cfg	The Power Supply Server configuration	Main panel	Control monitor
HF.sts	The status file for the High Frequency	Control Monitor, get from High Frequency	Process Syn-optic as result test executing
LF.sts	The status file for the Low Frequency	Control Monitor, get from Low Frequency	Process Syn-optic as result test executing

Table 1. Continued

Direction or File Name	Description	Write	Use
LM.sts	The status file for the Loss Measurement	Control Monitor, get from Loss Measurement	Process Synoptic as result test executing
PS.sts	The status file for the Power Supply	Control Monitor, get from Power Supply	Process Synoptic as result test executing
MMP.sts	The status file for the Magnetic Measurement	Control Monitor, get from Magnetic Measurement	Process Synoptic as result test executing
Pscycle.out	The received from the application real cycle	Control monitor, get cycle by FTP	Process Synoptic shows cycle
TMslaves.cfg	The file contains the controlled bench configuration	Main panel Install mode	Control monitor
Abort.int	The file, which is used for the interrupt the Test	Main panel Run mode	Control monitor
Activ_info_run.txt	The file includes the information about the active bench. It is sent before running the applications	Main panel Run mode	Control monitor
Passiv_info_run.txt	The file includes the information about the passive bench. It is sent before running the applications	Main panel Run mode	Control monitor

3.3.2 THE FILE SYSTEM FOR THE APPLICATIONS REMOTE CONTROL

All files permanently needed for the application layer will be kept in every *slave workstation* in a separate directory. These files can be located through the following path.

Slave workstation Name: /opt/home/incaa/A_common/RemControl

This directory also consists of various files, which are used to control the applications by the Test Master. These files are being changed every time a new test or sequence is activated. The list of files relevant to the application layer and their descriptions are given in Table 2.

Table 2. The Applications layer files

File name	Description	Write	User
HF.cmd	The command file for the High Frequency	Control monitor	HF, Commander
LF.cmd	The command file for the Low Frequency	Control monitor	LF, Commander
LM.cmd	The command file for the Loss Measurement	Control monitor	LM, Commander
MMP.cmd	The command file for the Magnetic Measurement	Control monitor	MMP, Commander
PS.cmd	The command file for the Power Supply	Control monitor	PS, Commander
TC.cmd	The command file for the Tcoil.	Control monitor	Tcoil. Commander
HF.int	The interrupt file for the High Frequency	Control monitor	HF, Interrupter
LF.int	The interrupt file for the Low Frequency	Control monitor	LF, Interrupter
LM.int	The interrupt file for the Loss Measurement	Control monitor	LM, Interrupter
MMP.int	The interrupt file for the Magnetic Measurement	Control monitor	MMP, Interrupter
PS.int	The interrupt file for the Power Supply	Control monitor	PS, Interrupter
TC.int	The interrupt file for the T-coil	Control monitor	Tcoil. Interrupter
HF.sts	The status file for the High Frequency	HF, Commander	Control monitor
LF.sts	The status file for the Low Frequency	LF, Commander	Control monitor
LM.sts	The status file for the Loss Measurement	LM, Commander	Control monitor
MMP.sts	Magnetic Measurement.	MMP, Commander	Control monitor
PS.sts	The status file for the Power Supply	PS, Commander	Control monitor
TC.sts	The status file for the T-coil	Tcoil, Commander	Control monitor
PScycle.out	The application real cycle	PS, Commander	Control monitor

3.3.3 THE FILE FOR THE APPLICATION REMOTE STARTING

The file system for the remote application started by Test Master keeps in a directory that has path:

Slave workstation Name: /opt/home/incaa/A_common/RemStartl.

The file *RemStart.ksh* contains the script for a start up Labview application. The application name points as parameter to the script. The VI programs for launching applications are placed in this directory too.

3.4 FORMAT OF THE BATCH FILES

3.4.1 FORMAT OF THE COMMAND FILE

Command file is a string that contains the commands and their parameters. Characters *\s* are used to divide a command and parameters. Characters *\n* are used to divide the commands. The file is completed by special command **ENDCMD**. The list of commands for every application is shown in the tables below.

3.4.2 FORMAT OF THE INTERRUPT FILE

Interrupt file always consists of the two following commands:

ABORT
ENDIND

3.4.3 FORMAT OF THE STATUS FILE

Status file is a string that contains the executed commands and result status. Character *colon (:)* is used to divide a command and its status message. The file is completed by command **ENDSTS.**

3.4.4 SYNTAX AND SEMANTIC OF THE TEST MASTER COMMANDS

There are several tables, which describe the Test Master commands and their interpretation by application.

A complete summary of the test master commands for Power Supply is shown in the following Table.

Commands	Panels	Action: push Button	Returned Status
ON	Main Panel	'ON'	Result status
OFF	Main Panel	'OFF'	Result status
SETUP	Main Panel	'SetUP'	
Type PS	Setup Panel	'OK'	

Commands	Panels	Action: push Button	Returned Status
ONSTB	Main Panel	'ON STANDBY'	Result status
RAMP TargCur, InpRamps	Main Panel	1.TargCur set at 'Input Ramp read' Click button 'SET RAMP RATE', 2.InpRamps set at 'Target Current' Click button 'EXECUTE RAMP'	Result status
INTERLOCKS	Main Panel	'Show Interlocks'	Result - list of 'INTERLOCKS'
	Interlocks Panel	'RESET and READ', 'MAIN PANEL'	
CYCLE File Name	Main Panel	'Cycle Editor'	Set in special out file "PScycle.out": measured Curren&Time Result in point
	Cycle Editor Panel	'FILE MENU' -"LOAD' –load cycle from 'File Name', 'Start'	
SWITCH Apert. (0-1), Posit.(0-4)	PS commander	Executing function 'SwitchBox_set.vi'	Result status
EXIT	Main Panel	'EXIT'	
ABORT	Cycle Editor Panel	'ABORT', 'Main Panel'	
	Main Panel	ABORT' ENDCMD'	"ABORT is execute"
ENDCMD		Ended doing Command File	"ENDSTS"

For the communication with the Test Master power supply application, the following files are being used:

PS.cmd – batch file (Command File)

PS.int – abort file (Interrupt File)

PS.sts - returned result (Status File)

PScycle.out – returned result of Cycle Editor

The following table contains the Test Master commands specification for LF PowerTestDAQ application.

Commands	Panel	Action: push Button or Command	Returned Status
ON File Name	InstrumentStatusAnd Control RUN PREPARATION	'ON' 'LOAD' file config from FileName, 'RUN'	Instrument status
OFF	InstrumentStatusAnd Control	'OFF'	Instrument status
EXIT	InstrumentStatusAnd Control	'EXIT'	

For the communication with the Test Master LF PowerTestDAQ application the following files are being used:

LF.cmd – batch file (Command File);

LF.sts - returned result (Status File);

This table contains the Test Master commands specification for HFMF PowerTestDAQ.

Commands	Panel	Action: push Button or Command	Returned Status
ON FileName	HFMFControlStatusPanel RUN PREPARATION	'ON' 'LOAD' file config from FileName , 'RUN'	Instrument status
OFF	HFMFControlStatusPanel	'OFF'	Instrument status
EXIT	InstrumentStatusAnd Control	'EXIT'	

For the communication with Test Master HFMF PowerTestDAQ application the following files are being used:

HF.cmd – batch file (Command File);

HF.sts - returned result (Status File);

This table contains the Test Master commands specification for Loss Measurement application.

Commands	Panel	Action: push Button or Functions	Returned Status
LOAD_MAG FileName	05_LM_MAIN_02-10	'Magnet Setting'	Action status
	LM_Magnet_Settings	'Load Settings' 'OK'	
LOAD_DAQ FileName	05_LM_MAIN_02-10	'Acquisition Setting'	Action status
	LM_Acquisition_Settings	'Load Settings' 'OK'	
LOAD_CH FileName	05_LM_MAIN_02-10	'Cannels Setting'	Action status
	LM_Channel_Settings	'Load Settings' 'OK'	
LOAD_CYC FileName	05_LM_MAIN_02-10	'Cycles Setting'	Action status
	LM_Cycle_Settings	'Load Settings' 'OK'	
DEL_CHS	05_LM_MAIN_02-10	'Cannels Setting'	Action status
	LM_Channel_Settings	'Delete All Channels' 'OK'	
PRE_RAMP nn	05_LM_MAIN_02-10	Set nn to PreRampRate	Action status
	LM_Acquisition_Settings.glb		
WSITCH Apert.(0-1), Posit.(0-4)	TeMa_LM_Exec_Cmd	Executing function 'SwitchBox_set.vi'	Action status
GO	05_LM_MAIN_02-10	'GO'	Action status
EXIT	05_LM_MAIN_02-10	'STOP'	Action status

For communication with Test Master Loss Measurement application the following files are being used:

LM.cmd – batch file (Command File);

LM.sts - returned result (Status File);

LM.int – abort file (Interrupt File);

PScycle.out – returned result of Cycle Editor.

This table contains the Test Master commands specification for Magnetic Measurement application.

Commands	Panel	Action: push Button or Functions	Returned Status
LOAD_HM File Name	Main Panel	In hardware mode, File menu (option load) [HM_Load_Save.vi]	Action status
LOAD_RM File Name	Main Panel	In run mode, File menu (option load) [RM_Load_Save.vi]	Action status
LOAD_RT File Name	Main Panel	In run mode, Button "Measurement Parameters" – button "Load RunType" [RM_LoadRunTypeSequence.vi]	Action status
LOAD_MS File Name	Main Panel	In run mode, Click on the magnet icon – button "Load Magnet Settings" [RM_MagnetSettings_Load.vi]	Action status
SWITCH Apert.(0-1), Posit.(0-4)	Main Panel	In remote mode, Click on the mux icon – button "Set position" [SwitchBox_ControlPanel.vi]	Action status
START_MM	Main Panel	In measurement mode, Button "Start" [MM_TestBeforeMeas.vi]	Action status
EXIT	Main Panel	File menu (option quit)	Action status

For the communication with Test Master Magnetic Measurement application use follow files:

MMP.cmd – batch file (Command File);

MMP.sts - returned result (Status File);

MMP.int – abort file (Interrupt File);

PScycle.out – returned result of Cycle Editor

This table contains the Test Master commands specification for Tcoil application.

Commands	Panel	Action: push Button or functions	Returned Status
START	Tcoil_main_panel	'START'	Action status
STOP	Tcoil_main_panel	'STOP'	Action status
WSITCH Apert.(0-1), Posit.(0-4)			Action status
EXIT		'EXIT'	Action status

For the communication with Test Master Tcoil application the following files are being used:

TC.cmd – batch file (Command File);

TC.sts - returned result (Status File);

TC.int – abort file (Interrupt File);

4. CONCLUSIONS

The Test Master is the scheduling and control software for the LHC magnet series measurements on the SM18 benches. Different applications are used for different magnet tests, which can be executed in local mode by the operator and in remote mode by Test Master control.

Using the Test Master facility, users with predefined access authorization (Expert, Manager, Operator) can define a set of commands for every application that are stored in a command file, and which will be executed to set the Data Acquisition Systems and to configure the measurement application. Such a set of commands defines a single test, and a sequence of tests defines a complete measurement cycle for a magnet.

The aim was to simplify the way to perform the measurements allowing test-operators with minimum experience to perform tests, and to minimize time and errors in settings-up the system.

The Test Master is in operation since last year and was intensively used, showing the high functionality and potentiality of such a system for the LHC dipoles series measurements.

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Горская Е. и др.
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Автоматизированная система управления
для серийных измерений LHC-диполей

В работе описывается программное обеспечение системы контроля и управления серийными тестовыми измерениями магнитов для проекта LHC, называемой тест «Мастер». Назначение системы — дать возможность автоматически планировать и выполнять процесс серийных тестовых измерений LHC-диполей оптимальным образом [1].

Тест «Мастер» представляет собой средний уровень в архитектуре программного обеспечения, разработанного группой CERN/LHC/IAS для центра управления всеми видами тестирования LHC-диполей в здании SM18 в ЦЕРН. Выполняя функции менеджера и планировщика для приложений, тест «Мастер» управляет всеми видами измерений, производимыми в кластере из двух тестовых стендов (bench).

Программное обеспечение разработано в среде LabVIEW.

Дана информация об интерфейсе пользователя, описаны архитектура программного обеспечения и используемые коммуникационные протоколы, приведены структуры и конфигурации файлов. Для каждого управляемого положения приведены структура команд управления и информация о состоянии работы.

Работа выполнена в ЦЕРН, Женева, и Научном центре прикладных исследований ОИЯИ.

Препринт Объединенного института ядерных исследований. Дубна, 2003

Gorskaya E. et al.
E10-2003-43
A Computer-Aided Control System for Automatic Performance
Measurements on the LHC Series Dipoles

The control system software (Test Master) for the Large Hadron Collider (LHC) magnet series measurements is presented. This system was developed at CERN to automate as many tests on the LHC magnets as possible [1]. The Test Master software is the middle layer of the main software architecture developed by the LHC/IAS group for central supervision of all types of LHC dipole tests in the SM18 hall. It serves as a manager and scheduler for applications, controlling all measurements that are performed in a cluster of two test benches. The software was implemented in the LabVIEW® environment.

The information about the interactive user interface, the software architecture, communication protocols, file-configuration, different types of commands and status files of the Test Master are described.

The investigation has been performed at CERN, Geneva, and at the Scientific Center of Application Research, JINR.

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Издательский отдел Объединенного института ядерных исследований
141980, г. Дубна, Московская обл., ул. Жолио-Кюри, 6.
E-mail: publish@pds.jinr.ru
www.jinr.ru/publish/