

Information Services in the TESLA Test Facility Control System

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Introduction

The TESLA Test Facility at DESY (Hamburg) consists of a linear accelerator for electrons and associated infrastructure to study accelerating modules based on superconducting cavities. Currently the machine operates with the first prototype acceleration section exceeding the design energy of 125 MeV. The final linac will produce about 1 GeV electrons and include a Free Electron Laser (FEL) and a synchrotron radiation experimental hall. The TTF is designed and built by the international collaboration. The components for the accelerator and the control system are supplied by different Institutions. The Distributed Object Oriented Control System (DOOCS) [1] integrates all these elements into one common control. To make the control system more reliable, it is very important to store the actual information about every control element and provide fast access to it. For the TTF control, problems of the storage and timely update of all necessary information are solved with the use of special service tasks or information services running on various computers connected to a local network. In this paper we want to describe the main TTF information services and their status, as of October, 1998.

1. Equipment Name Server (ENS)

The client part of DOOCS is based on the multiprotocol object oriented Application Programming Interface (API). The access to every parameter of a control device is provided with the use of its unique DOOCS name in the form: “facility/device/location/property”. It makes all applications independent from the realization and modifications of the lower level software but requires a service that would store the information about the names of all control elements, their control “coordinates” (the names of a host computer and a server program, for example) and the corresponding protocol parameters. Such a service in TTF controls is provided by a special DOOCS server — Equipment Name Server (ENS). ENS contains a central database with the mentioned above information and is consulted by client programs before the first data transfer to the device. The names query service which is missing in EPICS, for example, is also provided by ENS.

To improve the name service, the ENS has to run on more than one computer on the network. In these conditions, to inform all Equipment Name Servers about the last changes in the control system is not a simple problem. A lot of actions should be done synchronously on every such a computer. That is why it was created a special graphical tool (ENS_tool), a working partner for ENS. It is based on the DOOCS and X Window graphics libraries. When ENS_tool is invoked, then its main interface window appears on the screen of a computer or X-terminal (Fig. 1). This window contains a few buttons with names and comments that clearly define their functionalities.

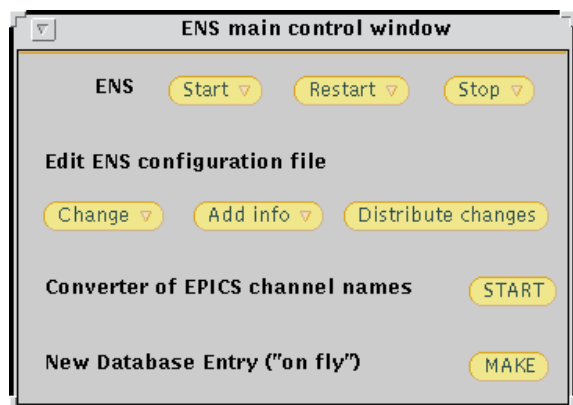


Figure 1: ENS_tool main interface window.

It is possible to start (the button ENS “Start”), restart (“Restart”) or stop (“Stop”) ENS on every computer that houses this server. One can also modify databases of all or any of Equipment Name Servers. It may be simple changes (one database entry) “on the fly” and more complex ones that require to restart ENS, to use text editors and even auxiliary software to convert, for example, EPICS channel names defined into EPICS real-time databases into the DOOCS control names. The last feature is especially important for our applications because allows us to relatively simply include EPICS channels into the common control system.

2. WWW Supported Document Management System

Today one can not even imagine our life without the universe of network-accessible information known as World Wide Web or WWW. Research centers all over the world have their own WWW pages. It is very important for the popularization of science and its applications.

The internationalization of scientific projects requires new ideas on the basis of WWW, such as an Engineering Management System. One of the first steps in this direction was made by CERN and the University of Helsinki that developed TuoviWDM, a WWW supported Document Management system (WDM). The tool has been designed to store documents on a WWW server and make them accessible through the World Wide Web. At that one is able to use all necessary security measures that are typical for computer system projects.

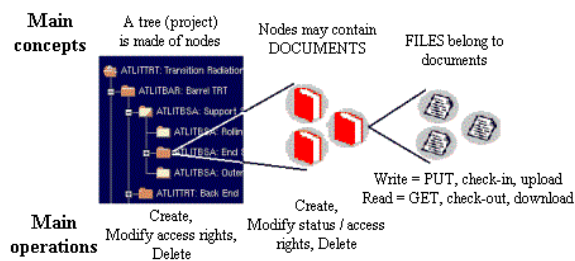


Figure 2: TuoviWDM concepts and operations.

Let us now make a brief description of TuoviWDM. The tool uses a tree structure as the basis for organizing documents. The tree is referred as a project. Each installation of TuoviWDM is capable to host multiple projects. The branches and leaves within a project are called nodes. The tree starts at the root node. Each node may contain other nodes and documents (see Fig.2).

Nodes and documents carry information (or metadata) about them. In case of documents it includes, for example, its status and type, owner identification, access rights, a description. Contents of a document (text, graphics) can be attached to it as files. The metadata of nodes may include a link to its owner, access rights, a short description and context of the node. Users communicate with the system by creating and accessing documents, nodes and their metadata, as well as reading and writing files attached to documents. Putting a file to the Web server is called check-in, getting it out to your computer for viewing or editing is known as check-out. In addition TuoviWDM has the next functions: user and group management, access control, structure management, advanced searches and hierarchical document classification.

TuoviWDM is installed on a DESY Web server with the address: <http://pia.desy.de>.

The program can be tested by the use of the identifier "guest" without a password. It supports now about twenty different projects, some of which are connected with the TTF and the future TESLA Linear Collider. DESY plans to gradually put as much as possible information about TTF into the TuoviWDM environment that should simplify the current work on the TESLA Test Facility and is very important for the international authorization of the TESLA project.

3. TTF Cavity Database (ORACLE)

More than 60 cavities will be installed in the TTF linac. Cavities produced by different European companies are tested at DESY and then assembled and installed into modules of eight cavities each. The TTF Super Conducting (SC) Cavity Database has been developed to collect and store the main parameters of cavities, from the production process to the operation in the TTF linac. The data collection is based on the ORACLE [3] Relational Data Base Management System (RDBMS) that is the standard database at DESY. ORACLE provides the access to data via SQL*Net from all computer platforms which are used by TESLA collaborators. At that, the 4-th generation language (4GL) allows complex queries and data crossing.

The database structure is a mirror of the main treatments and measurements of each cavity. According to this approach, all the data are divided into two groups: the parameters obtained under “warm” and “cold” conditions.

There are six “warm” sets of data essential to every cavity:

- Production data collected from the manufactures of cavities and from the entrance control at DESY.
- Information about the material used to build the cavities.
- Temperature, pressure and mass spectra from the heat treatments of the cavities in two different furnaces.
- Results from the buffered chemical polishing (BCP) and high pressure water rinsing (HPR) of the cavities.
- Information from the test stands about the cavity assembly.

Four important “cold” sets of data are the next:

- Temperature spectra from cooling down the cavities.
- Results of the cw (continuous wave) tests of the cavities.
- Data from cavity tests under pulsed condition.
- Information about testing and conditioning of input couplers.

Schematic structure of the database (Fig.3) shows that the different data sets are described by the corresponding set of tables. Each table is related to a specific cavity by its name, unique key generated from the data set code and timestamp of the treatment or measurement.

There are two possibilities to access information in the TTF database. The first one is suitable only for users who are familiar with the ORACLE SQL and SQL*PLUS languages. The second one is based on a Graphical User Interface (GUI) and was specially created to provide more friendly interface to the TTF Database.

The GUI uses the standard ORACLE Developer/2000 tools: Forms, Reports and Graphics. The structure and functionality of all GUI windows was designed in numerous discussions with the DESY hardware experts. Every GUI component starts from the “Start Window” containing a set of buttons with online help information on the applications related to them. This window appears when a user starts to work with the graphical interface (Fig.4).

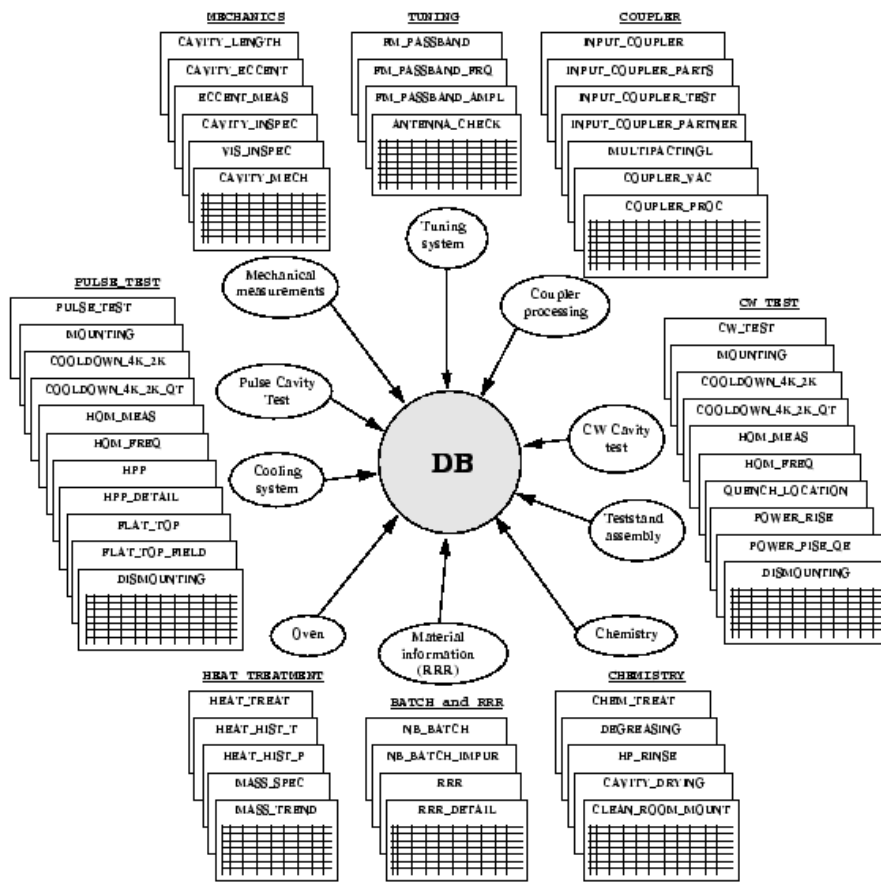


Figure 3: Schematic structure of the Cavity Database.

All the forms are divided into the next three groups (see Fig.4):

- SUMMARY INFORMATION – the forms of this group present “horizontal slices” from the database tables that combine measurement data from any treatment and test together.
- DETAIL INFORMATION – this group of forms is oriented to present “Vertical slices” with the data of a simple treatment or test.
- LOGISTICS INFORMATION – with these forms a user gets the access to the “notebooks” of cavity processing steps and statuses.

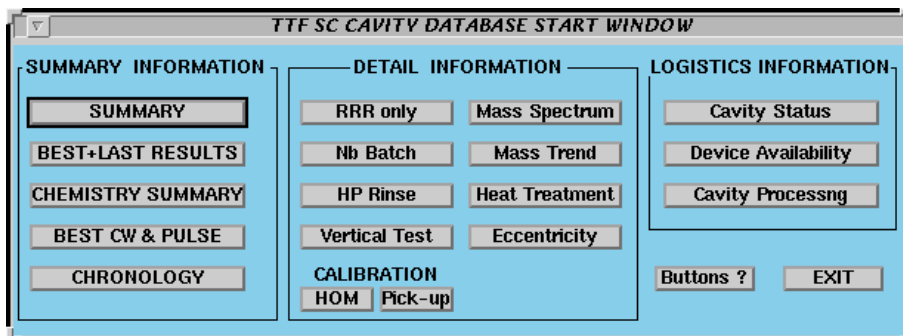


Figure 4: GUI Start Window.

The most important component of the first group is the “SUMMARY” form that contains the information on most important treatments and tests of a cavity in the chronological order (Fig.5). The main window of this form appears if the button “SUMMARY” in the start window is pushed.

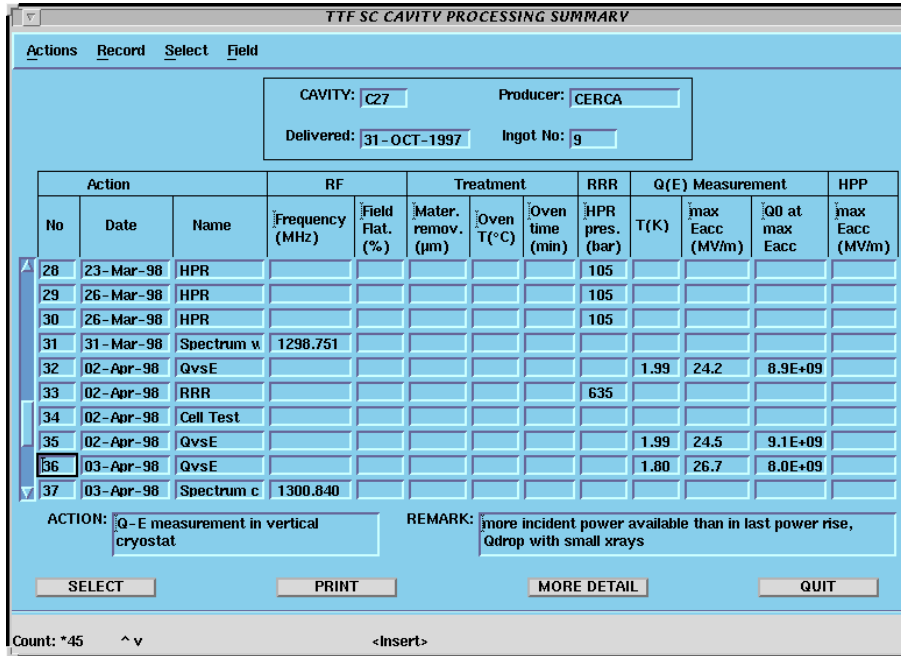


Figure 5: SUMMARY form.

The combination of the action name, action date and “MORE DETAIL” button shows the detailed information about every action in an additional window (Fig.6). Once appeared, the additional window updates automatically when a user positions on records with the corresponding actions.

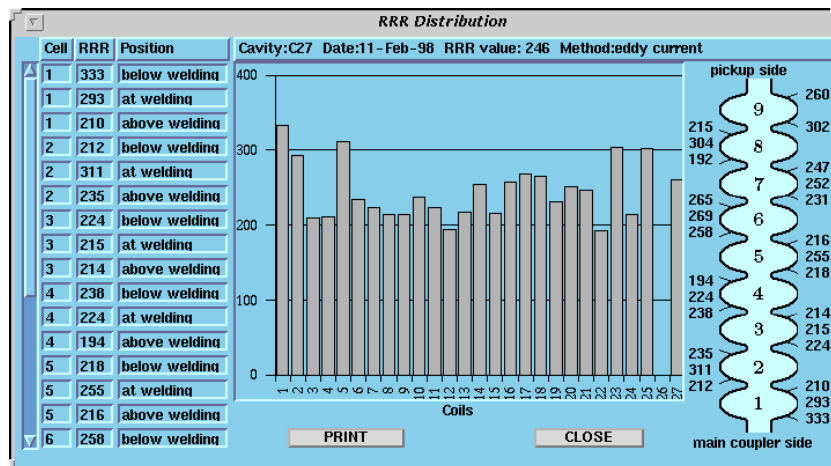


Figure 6: Cavity material properties.

Another helpful window from the second group of forms contains information on the heat treatment of the cavities (Fig. 7).

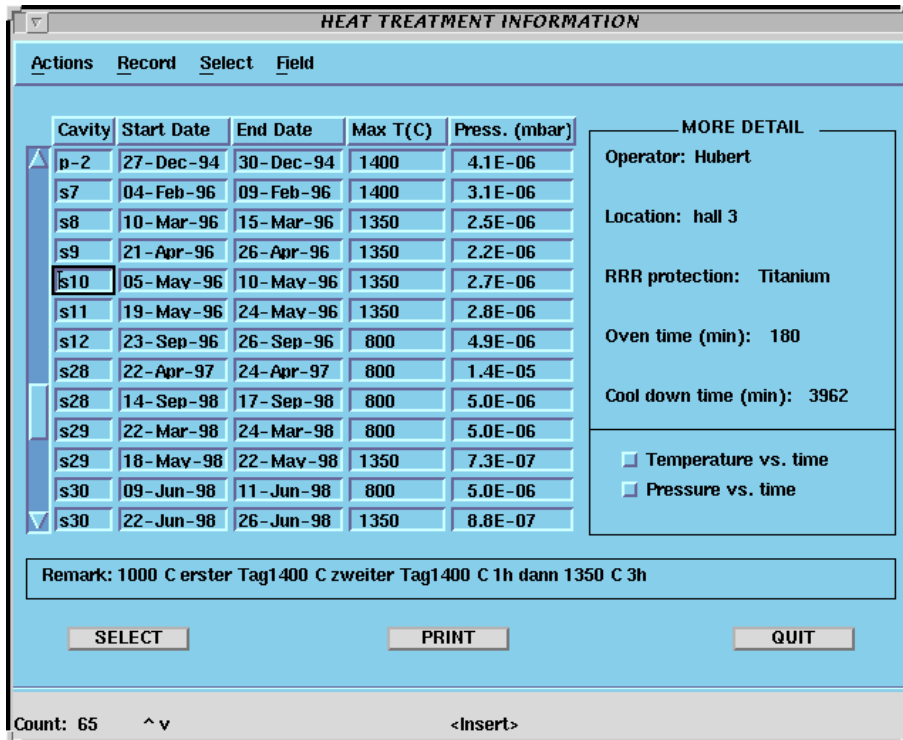


Figure 7: Information from Heat Treatments of cavities.

By pressing the button “Temperature vs. time” or “Pressure vs. time” the temperature and pressure spectra respectively are displayed as a function of the treatment time (Fig. 8).

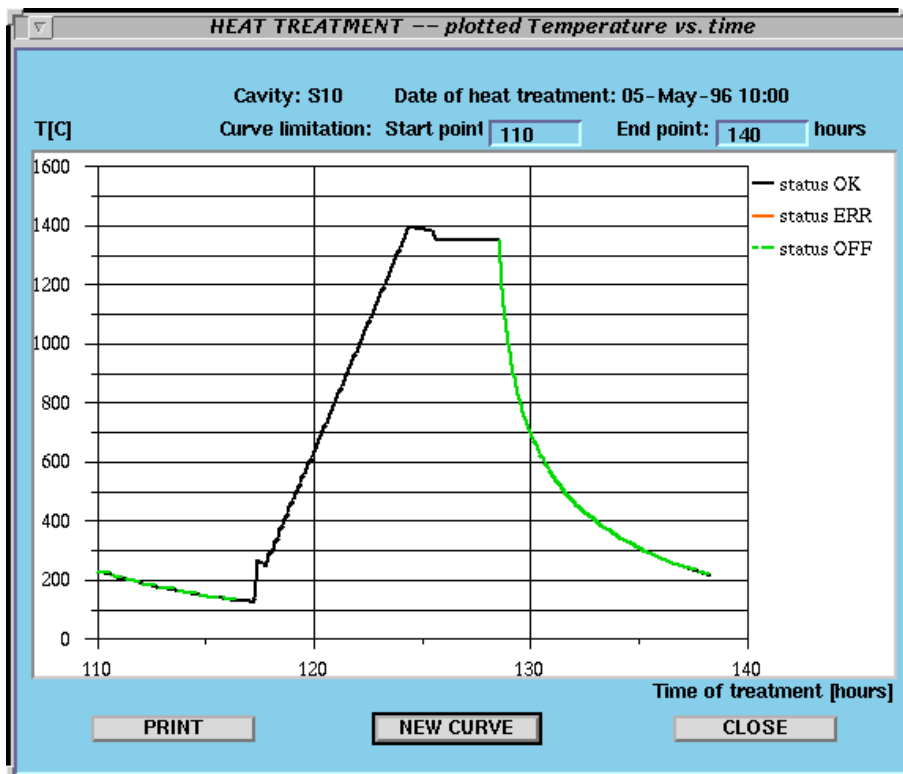


Figure 8: Temperature development during the Heat Treatment.

Nearly all windows of the GUI have “PRINT” buttons connected with the Report Generation System (RGS). The RGS is the special stand-alone subsystem of the graphical interface that permits to produce a hard copy of the window outlook (Fig. 9).

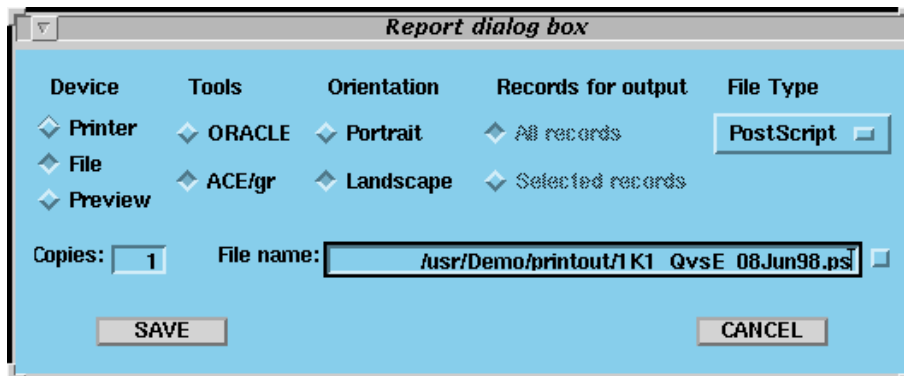


Figure 9: RGS window.

The RGS is based on the ORACLE Reports and Graphics as well as on “ACE/graph” that is the additional tool for the graphics generation. The combination of these applications makes it possible to save outputs in many formats including Postscript and ASCII. To define the output device, the RGS includes two additional windows. The first one is the “File dialog” that permits to select a directory and a file to save output and is oriented on a Unix-like File System. The second window that is called “Printer selection” shows the list of all printers available from the current HOST computer at the moment.

In the future, the database structure and GUI have to be enlarged to take into account the measurements of the accelerating modules containing eight cavities and, finally, the whole TTF linac. To make the GUI accessible for more and more users, we plan to increase its power with the use of the ORACLE WebServer that will generate dynamic Web pages with the actual information from the database.

Conclusion

The work on the TTF shows us that the separation of the information part of our control system into special service tasks is very efficient. It significantly reduces the information load on the API libraries and makes control applications very compact. The participation in global information projects is not a problem, because the access to the actual parameters of the equipment is provided in a very transparent way.

References

- [1] O.Hensler et al. “TESLA Test Facility Control System and its Current Status”, this Conference.
- [2] H.Kammerlocher. “TuoviWDM at DESY”, DESY internal presentation, March, 1998.
- [3] ORACLE Forms Reference Manual. Release 4.5. Part No. A32507-2. – ORACLE Graphics (TM) Reference Manual. Release 2.5. Part No. A32483-1. – ORACLE Reports Reference Manual. Release 2.5. Part No. A32489-1.