THE SUPERCONDUCTING CAVITY DATABASE FOR THE TESLA TEST FACILITY

P.D. Gall†, A. Gössel, V. Gubarev, DESY, Notkestr. 85, 22603 Hamburg, Germany

Abstract

Data from about 90 superconducting 9-cell cavities tested at the TESLA Test Facility TTF have been stored in a database. 30 more 9-cell cavities are expected in the next years. In addition information about superconducting single and double cell, 4-cell, 5-cell and 7-cell cavities has been accumulated. The database was developed to collect data of every preparation step and measurement result on these cavities in order to optimise production and preparation techniques for the cavities needed to meet the ambitious TESLA goal of high accelerating gradients at high quality factors. Therefore interfaces were created which enable the users to select and analyse the stored data easily.

It is clear that a cavity database is also important for a linear collider like TESLA in order to keep track of the various treatment, testing and assembling steps of more than 20,000 superconducting cavities. The treatment procedures must be fixed before the series production and preparation of the TESLA cavities starts and so the database should become an effective part of the quality management system.

1 INTRODUCTION

Up to now about 90 superconducting 9-cell 1.3 GHz cavities, produced by different European companies, have been tested at the TESLA Test Facility (TTF) at DESY. 30 more 9-cell cavities will be delivered and tested in the next years. Finally the cavities are assembled and installed as modules of 8 cavities in the TTF Linac [1]. Furthermore an R&D program with single and double cell, 3-cell, 4-cell, 5-cell and 7-cell superconducting cavities has been initiated in order to optimise production and preparation techniques for the cavities. Some of these cavities have been tested already or will be tested within the next months. Selected data are collected into a relational database to keep track of every preparation step and test result on the cavities. This database assures a reliable tool for comparisons and analyses by accessing the data from anywhere in the TESLA collaboration.

2 DATABASE STRUCTURE

The cavity data are stored into more than 100 tables, the basic structure of a relational database, representing for each cavity the essential checks, treatments and measurements [2]:

- Production data provided by the manufacturers of the cavities and by the acceptance inspection at DESY;
- Essential properties of the materials used to build the cavities;
- Results from cavity eccentricity and frequency tuning (field flatness) measurements;
- Temperatures, pressures and mass spectra for the heat treated cavities;
- Parameters and results from degreasing, buffered chemical polishing (BCP) or electropolishing (EP), and high pressure water rinsing (HPR) of the cavities;
- Information about the cavity assembly to the vertical and horizontal test stands and the results from testing the cavities under cw and pulsed conditions;
- Data about testing and conditioning of input couplers with and without cavity.

One or more tables are used to describe these different cavity data (Fig. 1). Each table is related to a specific cavity by the cavity name and a timestamp for its treatment or measurement. We use the ORACLE Relational Data Base Management System (RDBMS) to achieve our conceptual model of the cavity handling at DESY. The ORACLE RDBMS is accessible via SQL*Net from all the different computer platforms used in the TESLA Collaboration. ORACLE uses SQL, the Structured Query Language, and allows complex queries and data crossings. Up to now the superconducting cavity database contains about 100 Mbytes of data.

3 DATA COLLECTION

Data collected from different preparation steps and measurements using different host computers are either loaded directly to the database through Oracle Forms or by using embedded SQL (Pro*FORTRAN) to handle ASCII files. ASCII files are either generated directly or via a special command language to parse and extract data from user-defined text files. The files are catalogued for bookkeeping and to assure the possibility to delete some data in the database and load them again which is unavoidable in the developing phase of a new preparation or measurement technique. The most important data are updated within a day, whereas other data – like the timetables of the processed cavities and the availability of important preparation and measurement devices – are normally updated only once a week.

†dieter.gall@desy.de

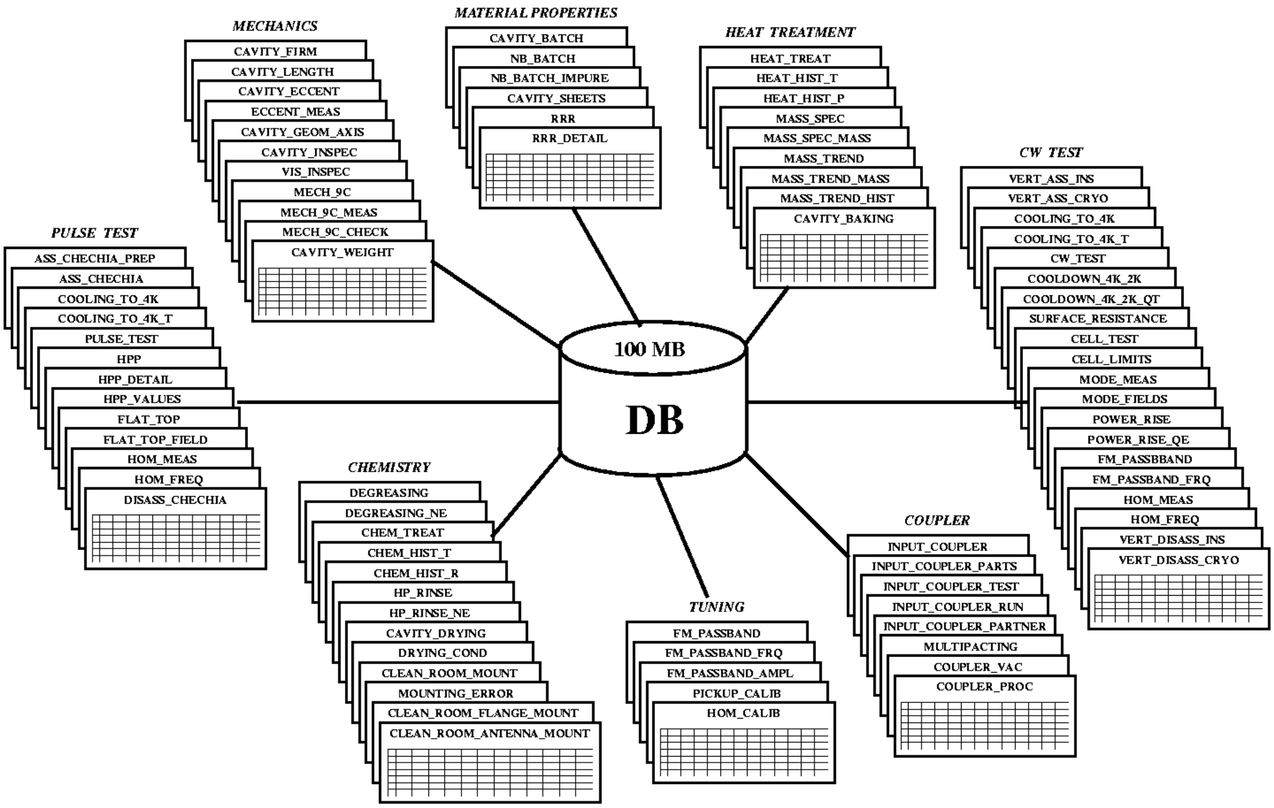

Figure 1: Schematic structure of the TTF superconducting cavity database.

4 DATA MANIPULATION

4.1 Views

In order to have easier access to the data collected in the database we created *VIEWS* which are logical tables based on one or more tables of the database. Some views collect data from tables corresponding to one cavity treatment or measurement type, e.g. the view gathering information about the tests under cw conditions (3 tables involved).

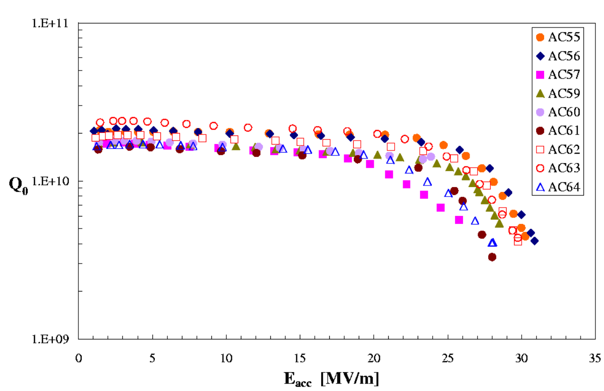

Figure 2: Excitation curves of AC-Cavities generated by MS EXCEL/ODBC from the view *Last_Test_Results.*

On the other hand the *SUMMARY* views combine data from tables describing different cavity preparations and/or measurement procedures, e.g. the view *Last_Test_Results* combining data about the treatment and measurement history of the cavity (about 10 different treatments and measurements from 20 tables). The views facilitate the direct access to complex data queries. The queries may be handled by native SQL scripts or client programs like MS EXCEL using ODBC (Open Database Connectivity) drivers as done to generate Fig. 2.

4.2 Graphical User Interface

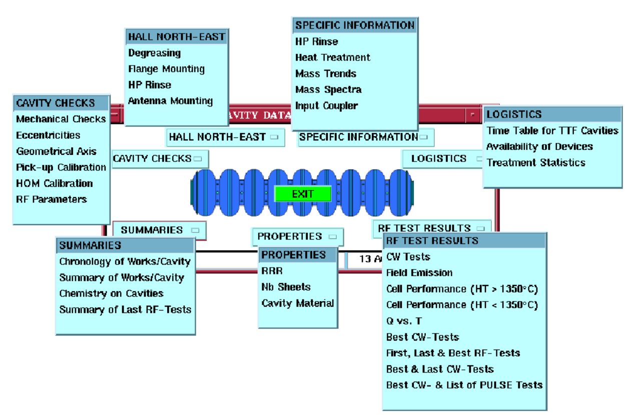

Figure 3: Start menu of GUI for the TTF cavity database.

A Graphical User Interface (GUI) for the TTF superconducting cavity database has been created as one large multiform application based on the ORACLE Developer 2000 Tools Forms and Graphics in order to provide a user-friendly way for viewing and analysing the accumulated data (Fig. 3). It has been implemented [3] and permanently expanded in interaction with the users involved.

The GUI is entirely based on about 40 views. It represents the data either in such Forms where the results of just one cavity can be selected from a list of cavities, e.g. in *Summary of Works/Cavity* (Fig. 4), or in multiframe Forms where the data of all cavities or a selected group of cavities may be compared, e.g. in *Summary of Last RF-Results* (Fig. 5).

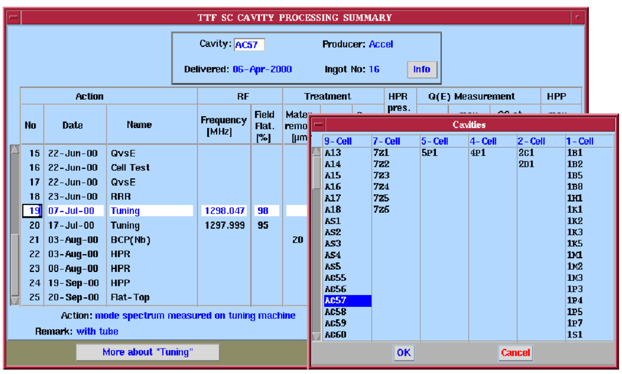

Figure 4: Summary information on treatments and tests done on cavities in chronological order from *Summary of Works/cavity* in the GUI. A special cavity has to be selected from the list.

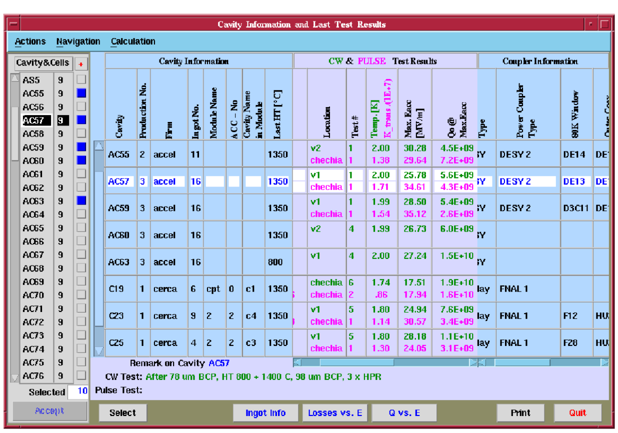

Figure 5: Results of last cw and pulsed tests of selected cavities from *Summary of Last RF-Results* in the GUI. A group of cavities may be selected.

In order to permit inexperienced users to manipulate data inside Forms we created a special regime to filter the data (Fig. 6).

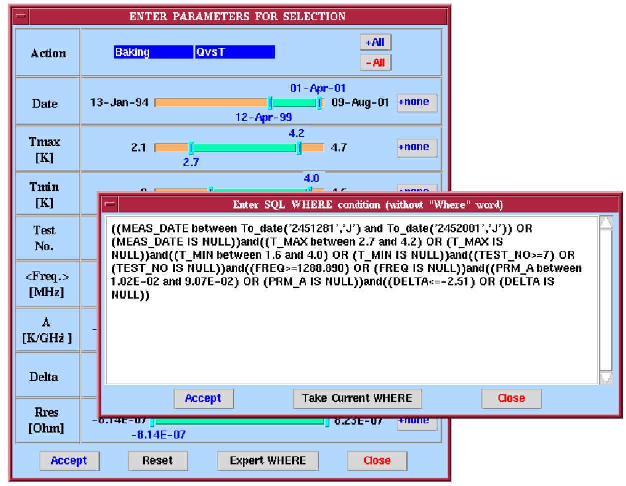

Figure 6: Special regime to filter data either interactively or manually.

4.3 Report Generation System

In order to printout the results provided by the GUI a Report Generation System (RGS) was developed. This RGS is based on Oracle Reports and Graphics and was designed to produce *Table*, *Graphical* or *Informational (combined) Reports*. Alternatively the RGS may generate Postscript or ASCII files which can then be used by MS EXCEL or other tools to present the data in a user-defined style. Every application of the GUI contains a button *PRINT* that is linked to the RGS. Fig. 7 shows an MS EXCEL plot based on the ASCII file produced by the RGS called from the topic *Summary of Last RF-Results* in the GUI.

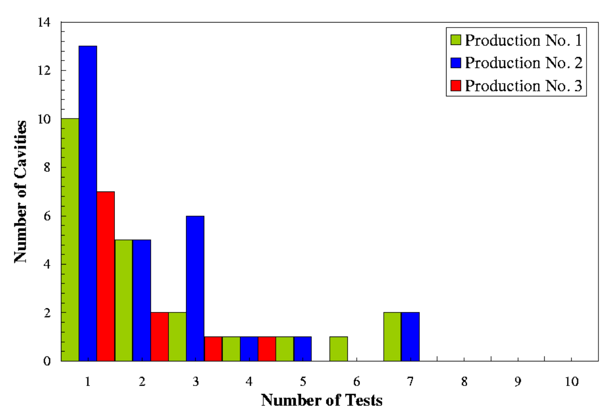

Figure 7: Number of cw tests needed to reach maximum gradients for cavities from different production series. It is provided by MS EXCEL based on the ASCII file generated by the RGS called from *Summary of Last RF-Results* in the GUI.

5 FUTURE DEVELOPMENT

It is clear that a cavity database is essential for a linear collider like TESLA in order to keep track of the various treatment, test, and assembly steps of more than 20,000 superconducting cavities. The actual database should help to fix the treatment procedures for the series production and preparation of the TESLA cavities and so a TESLA database should become an effective part of the Quality Management System. As it is not recommendable to change the structure of the database during the project it is necessary to define the structure carefully at the beginning. Therefore the design of such a database system and simultaneously its user interface should start soon.

6 REFERENCES

[1] D.A. Edwards, TESLA Test Facility Linac – Design Report, TESLA 95-1, 1995.

[2] B. Aune et al., “Superconducting TESLA Cavities”, Phys. Rev. ST Accel. Beam 3, 092001, 2000.

[3] P.D. Gall et al., “Superconducting Cavity Database for TTF”, Proceedings of the eighth Workshop on RF Superconductivity, Abano Terme, Italy, Vol.III, p.440, 1997.