

## LHC Project Note 396

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### Data base for Interconnect welds

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#### Summary

The interconnect work for the LHC equipment involves a large amount of data and files generated by the machines and the tooling. Different kinds of technologies for different kinds of interconnections result in different data, file types and file formats. This data should normally be stored in the MTF, file by file. This was too time consuming and error prone. In order to free time for quality control to improve the correct handling of the data files and information a data-base system was developed to organize and handle as automatically as possible dataflow and checks. This was the first goal set up. This is now in operation and is giving satisfaction in industry and at CERN. An important bonus of a data base system is that we can get an overview of the quality of the data and make possible feed back to the process. For the moment we cannot see clear correlation between data and non conformities which means that the tuning of the tooling is satisfactory. It is important to have efficient access to the data to check correlation with possible failure related to ageing due to interconnect work, during the LHC lifetime.

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#### 1. Introduction

In the MARIC (24/5 2006) a request for support for the interconnection work was expressed. With the experience of the production steering using magnetic and geometric data bases, MSC/MA could support this request efficiently by re-deploying the existing software tools. A software system, built on a data base to check, organize and store the production data, was set up. Here we had a solid and efficient library of procedures and methods that could be redeployed to efficiently develop the software system for the interconnection data. The software is integrated in the IT J2EE public service system. The data base system is standard CERN ORACLE (ACCDB).

The first step was to get the data correctly and completely into the MTF for standard upload to the data base system. 50% percent of the files were missing, 15% percent was put in the wrong place in the MTF, 10 to 50%, depending of the work-package, contained incomplete information. A selection of data files from the data storage cards had to be made by IEG to get the most correct file into the MTF, all files could not be put in due to time constraints. The task to correct all this by the firm and restore in MTF etc. was not possible with available manpower. The idea was then to “dump” the information from the data card without manual treatment into a CERN dfs folder, to be handled, sorted, checked and organized automatically by the data base and the software system. Not good files are rejected and put in a special dfs folder to be re-treated by the firm. The MTF is not used for storage of the source files as it is

usually for our data bases. However the MTF can see the data from the data base so the solution is transparent. Some of the files have to be extracted using specialized software developed for the welding machines (different for different technologies). This work is done by hand, file by file, by the MCS/MA team to get all data correctly into the data base. For some technologies this work can be done by software.

The interconnect data base is linked to the layout database and the MTF system (TS department) by views.

This work has permitted to increase the quality of the data and also to improve considerably the availability of the data by requiring that all data can be retrieved. Actions by the firm, to avoid destruction of data cards due to the electromagnetic environment, have been very successful. The availability of data files is now approaching 100% (from about half before their intervention on the machines).

During the development, the person working part-time on this system left and to continue the work a replacement had to be found very rapidly. With the kind help from a software expert in the EDMS team we could save this work and continue the development without a major stop. Thanks to the quality, organization and documentation of the software system it could be handled over to a software expert within a very short amount of time.

## **2. Brief Description of the application**

The different welding and soldering technologies are handled separately. They are

1. IWP 01.010 TIG orbital weld of PIM (Plug-In Module)
2. IWP 01.020 MBB Soldering
3. IWP 01.030 Ultrasound Spool Welding M1 and M2 lines
4. IWP 01.050 Tig Welding C, E, K, M1, M2, M3 lines

The web interface has been designed to give an overview of the

- a. data completeness, including display of the measurement data in the files.
- b. the quality of the work based on quality criteria.

The data completeness is intended to show that data files for the interconnect work are available, and stored in the data base. The number of files per interconnect indicates how many time the work has been restarted. Direct access to the MTF folder for the interface is available and a summary diagnostics by moving the mouse over the status indicator (red, green or yellow for no files, ok, and incomplete or bad format etc. respectively). On line statistics of the data completeness per sector is available on the interface. Files containing photos are stored and will be accessible from the interface. All data can be displayed including a short summary of the parameters characterizing the work, calculated on the data acquisitions.

The data quality interface shows if data are within alarm limits. If not, a diagnostic message is given. Statistics of the work per sector is being implemented. Non-conformities are displayed on the interface and are displayed in red if not closed. All EDMS document references are available on the interface. Alarm values are put in the system. For the moment they correspond

to settings discussed between CERN and the Firm from experience related to the different technologies. They can be modified according to new findings, if necessary.

The system is now completed so that statistics can be made to distinguish outliers and alarm limits. The first studies on correlations and non conformities are now under way in collaboration with experts on the different technologies.

A first overview has been made of the ultrasound welds for which we cannot see trends with production speed-up. Detailed statistical work for all work packages has now highest priority.

To access the application to see progress data completeness and alarms and non conformities needs registration (request can be sent to R.Lyzwa with copy to E.Wildner). The web address is

<http://at-mas-pda-root.web.cern.ch/at-mas-pda-root/>

and the application is accessible under Data Completeness and Data Quality in the box “LHC interconnections” (left part of the application the window).

### **3. Conclusion**

The experience and software tools gathered and produced for the warm magnetic measurements and geometry DB's have permitted a rapid answer to an urgent request for quality control of interconnect welds. We are now capable of efficiently collecting the data-files from the interconnection work. Data base technology gives us the possibility to efficiently analyse and visualize information.

### **4. Acknowledgements**

N. Emelianenko, R. Lyzwa (TS/CSE), Z. Gao developed software and data bases and made tests. Olivier Denis supplied technical specifications. D.Tommasini and F. Bertinelli have actively supported this work.

## Annexe Examples

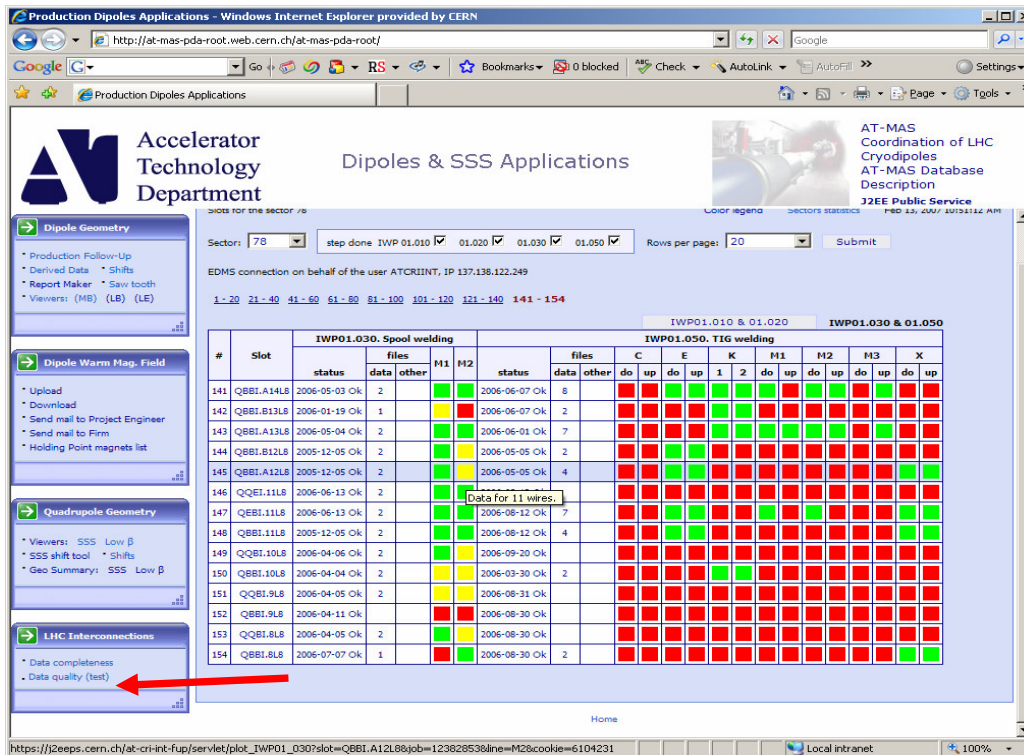


Figure 1 : Data completeness interface: sector and work package to be selected. Files available or not (green/red) and a diagnostic (little yellow rectangle) for other problems (yellow). By clicking on the interconnect we get the MTF folder.

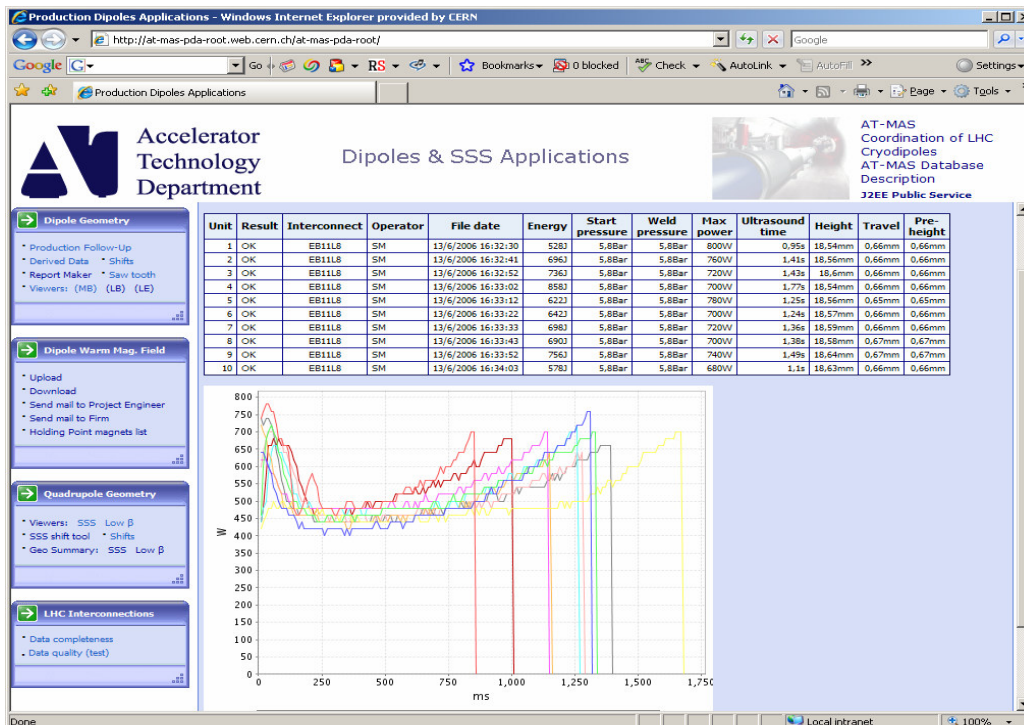


Figure 2 : The information in the files is displayed when clicking on the green (ok) button in the completeness interface.

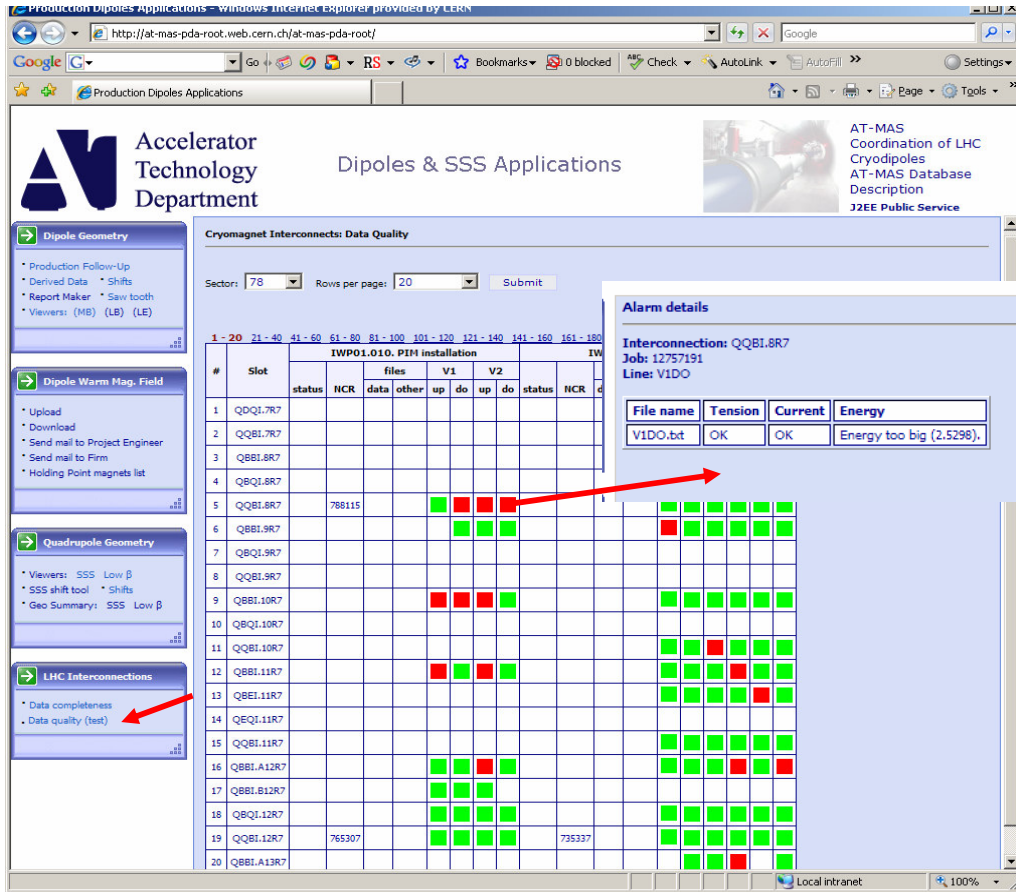


Figure 3 : Alarms on data is shown as red. By clicking on the red square the diagnostics comes up. Non-conformities are red if not closed.

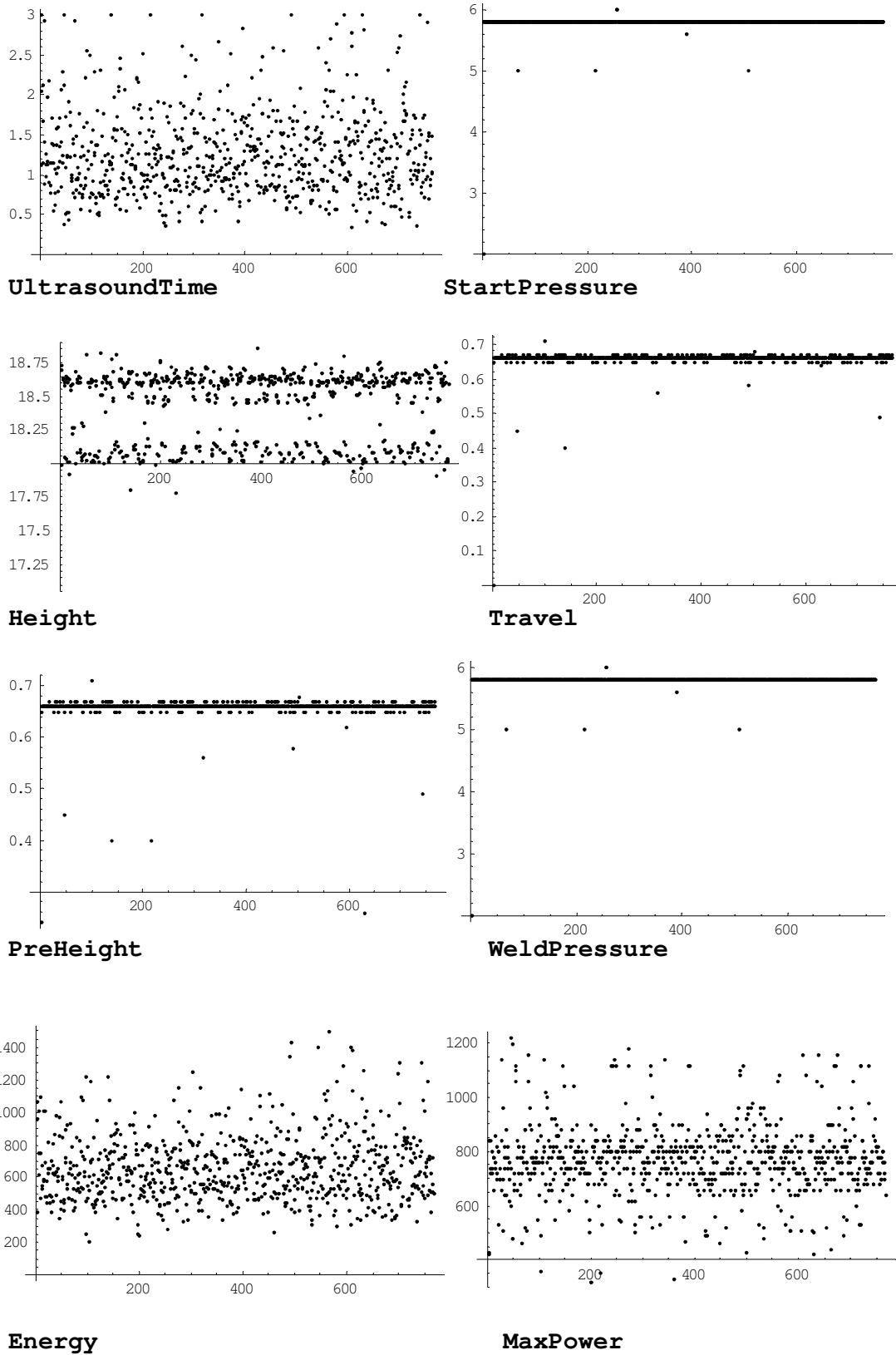


Figure 4: Example of a data extraction for all US welding for wire 6, time evolution.

## **References**

- [1] Authors might want to give a list of references.
- [2] A style like the one used for accelerator conferences like EPAC and PAC are recommended.
- [3] To reduce space, the reference list may be put to a smaller character font, e.g. Times 10.

## **Appendix A**

This is one way to reference an Appendix which may be put on separate pages, if required.