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LARGE SCALE DEPLOYMENT OF MTF AND LESSONS LEARNED

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Abstract

The MTF system was developed to capture the design, manufacturing, test and installation data of equipment built for LHC. Today, more than 120.000 descriptions of LHC equipment are being managed with the MTF. The acquisition of the equipment data is both an organisational and a technical challenge. For expensive equipment such as the LHC dipoles a reliable and robust non-conformance methodology must be put in place, the MTF provides the required information technology support tools. The EDMS Service has developed methods, training processes and tools to cope with an extensive use of the system, a use which will grow during the next years until LHC is installed. This paper presents the experience acquired and the solutions put in place.

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1 INTRODUCTION

The MTF application is an integral part of CERN's EDMS (Engineering Data Management System) and it was developed to capture manufacturing and installation data of equipment built for LHC. The MTF project was launched during 2000; it became an official service in 2001 and today more than 120.000 descriptions of LHC equipment are being managed with the MTF. The experience gained with the dipole manufacturing process tracking and the methods established are now applied to other complex systems (SSS, QRL) for both manufacturing and installation follow-up.

2 MTF SYSTEM

The MTF application manages today an impressive amount of technical information about the LHC equipment. This includes general data such as part identifier and manufacturer name but also very specific properties of the individual equipment. An important part of the MTF is the workflow tracking capabilities, handling data and documentation about the different steps in the manufacturing and test processes. For each individual step, information about scheduling, applicable standards, results and possible non-conformities can be stored and retrieved. The MTF was developed using the EDMS Common Layer, our interface to two mainline commercial applications: Axalant for project and document management and MP5 for equipment management. MP5 is the CERN and LHC Asset tracking and maintenance management system that will be also used to provide support for INB traceability regulation activities. The architecture of the MTF system is described in more detail in [1].

3 MANUFACTURING FOLLOW-UP WITH MTF

3.1 Main dipole manufacturing follow up with MTF

The first client of the MTF application was the group responsible for the LHC main dipole in the AT Division. The complexity of the dipole design, the requirements on the traceability of components and geographical distribution of production sites made this first MTF project very challenging both from the technical and organizational viewpoints.

The requirement for traceability of components and the availability of their manufacturing information implied the need for rapid introduction of MTF application in the manufacturing process and quality control of all traced components, about 120. Given the specificity of the dipole supply chain, where CERN appears as a component supplier to the cold mass assemblers and to the cryostat assembly consortium, the campaign of MTF introduction for components was coordinated from CERN, by the EDMS Service. A valid strategy was implemented from the start: the registration of components is under the responsibility of the CERN project engineers who are in charge of the manufacturing follow-up. All concerned project engineers and technicians from many different AT groups were contacted individually; the policy of MTF deployment, the type of data contained and the data collection procedures were elaborated for each individual case. The consultancy effort invested from the side of the EDMS Service in the start-up phase was both extensive and intensive, no practical experience with the deployment of the tools was available and good examples were yet to come.

During the pre-series production of cold masses, the collection of data at the three (Cold Mass Assemblers) CMAs side was done using MTF transfer files, based initially on Excel and later on an Access application. The data was sent to CERN before the delivery of each magnet and then imported in the MTF database by the EDMS service. At the same time, different teams working on the cryodipole assembly and test activities in SM18-SMA18 started using the MTF Web interface from the start of their activities for online reporting of executed steps, management of non-conformities, traceability and verification of components. With the close collaboration between EDMS Service and Cryodipole coordinator, and thanks to almost daily feedback given by the CERN teams (CRI, MTA, ACR, TS-SU) and the ICS consortium, the MTF evolved in few months from an archiving system into a tool which supports coordination of activities in the field, used by managers, engineers, technicians and operators at the shop floor. A method for the reporting of non-conformities and follow-up of corrective actions was defined and successfully deployed in the field: this method is now generalized and makes part of the LHC QAP Procedures [2]. The MTF feature that permits the automatic sending of an e-mail on a workflow step closing action is widely used to inform CERN project engineers , industrial support teams and equipment supplier how an equipment progresses throughout its life-cycle. The automatic generation of EDH transport requests upon closing of an action in MTF is presently being implemented in collaboration with the AIS team.

Following two years positive experience with the MTF Web use at SM18-SMA18 and in order to profit from the developed methods and tools in particular regarding the NCR tracking, it was decided in late 2003 to introduce the same model at the CMA sites. The EDMS Service organized on-site training sessions and now all 3 CMAs are using the MTF Web directly for registration of data, see Figure 3-1. This has contributed to an improved quality of data, better non-conformity tracking and avoids any extra processing steps for data import at CERN.

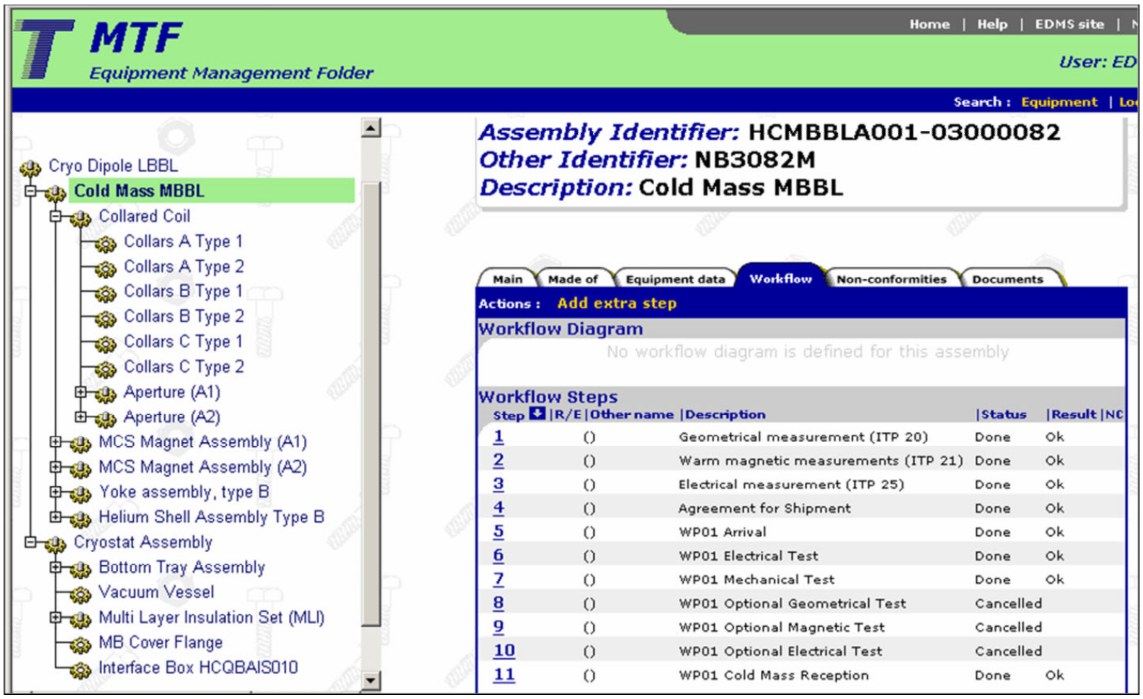

Figure 3-1: *A typical screen-shot from the MTF Web application, showing the status of the work progress on a cold mass. The data related to the first four steps is entered by the corresponding CMA, the rest is filled in at SMA18d*

3.2 MTF for other complex systems

The tools and methodology developed for the manufacturing follow up of main dipoles is now being applied to other complex systems, namely SSS and QRL. The start-up phase for the new MTF projects is now significantly reduced. In the SSS case, the MTF has been very rapidly introduced in the manufacturing follow-up for majority of components: the concerned project engineers being in most of the cases the ones already using the MTF in the dipole context. The implementation of MTF for SSS assembly works and tests at CERN (904, SM18) has also been rapid, thanks to the effort of the SSS Coordinator and the MTF dipole experience of involved teams. The main challenge consists now in introducing the MTF on the SSS CMA side. This will require first of all an effort on the CERN side to define an action plan and closer collaboration between the project engineers in charge and the main MTF dipole protagonists.

For the QRL and its elements, the MTF has been successfully introduced in the manufacturing follow-up: the process has been very rapid and efficient thanks to the very good preparation of the responsible CERN team. The application is now being extended to collect the installation data and the first results are already available, see chapter 4.

4 MTF IN THE INSTALLATION PHASE

The MTF features are being extended to provide support for the installation activities in the LHC tunnel. Names, positions and structure of LHC equipment slots are provided by the LHC Layout Database and imported. The MTF will be used to record the information about what equipment is installed or will be installed in a given slot and what activities have been executed or will be executed at a given position.

The first application of MTF in the installation context has been used for the tracking of non-conformities related to the installation of general services. The procedure for recording and follow-up of non-conformities [3] was elaborated from the existing procedure used in the manufacturing context. A reporting tool has also been developed which allows a rapid access to all open NCRs, sorted by location or class (critical, non-critical).

The present efforts of EDMS Service are concentrated on providing the tools and methods to support the follow-up of the installation of the machine components. A close collaboration has been established with two equipment installation team: QRL and LHC interconnections, which enables both the validation of existing concepts and possible further extensions of the system functionality.

The QRL installation data is being collected by the contractor, in Excel format. The data is extracted and imported into MTF on a weekly basis, see Figure 4-1. The possibility of having a more interactive reporting in the future is conditioned by the contract terms and internal sub-contraction organization of the main contractor.

The follow-up of the installation of the LHC interconnections and the related quality control activities will be supported by daily reporting in MTF. Assuming the absence of a fast network connection in the tunnel, the EDMS Service is preparing an offline MTF interface which will allow the teams working in the tunnel to collect the data about executed operation during the day and to package the related documents containing measurement results into a single file. At the end of the day, all collected data will be compressed, brought to the office and submitted to the EDMS Import queue to be processed overnight. The following day, the responsible project engineer will be able to access the loaded data and monitor the progress of installation work.

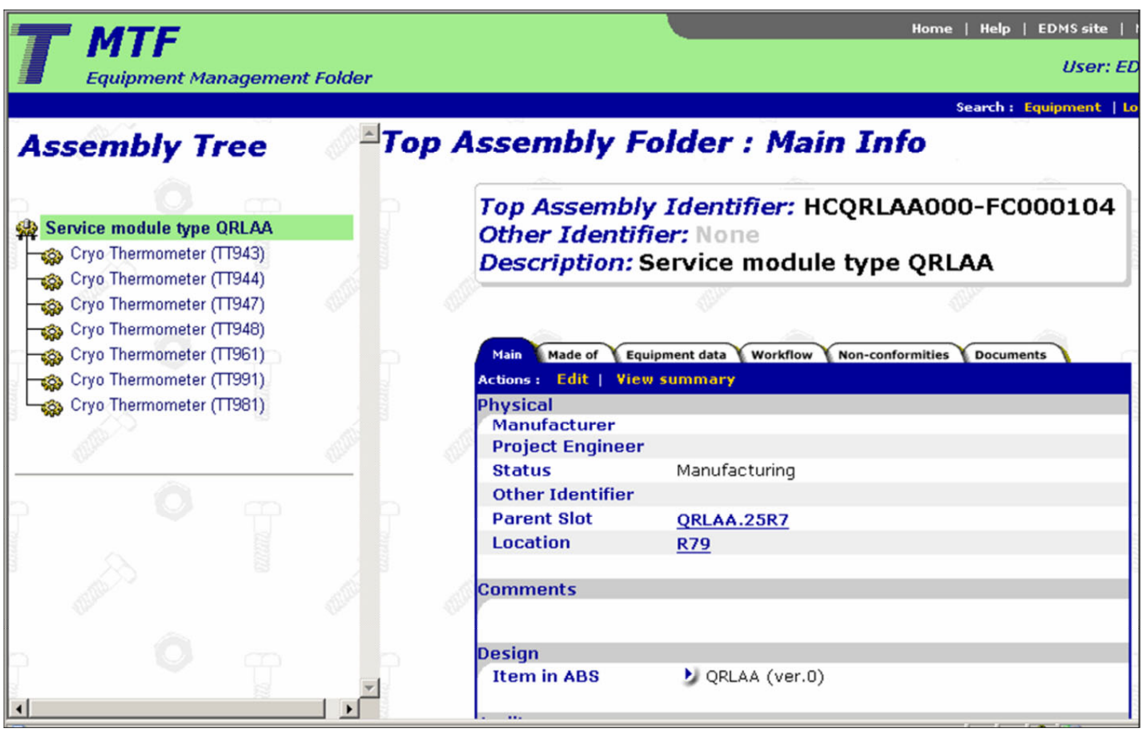

Figure 4-1: *A service module installed in the machine slot QRLAA.25R7.*

5 SCALING-UP OF THE SERVICE

5.1 Information campaigns and user training

Early in 2003, an MTF workshop was held to familiarize project engineers and technician with the features of the tool, to explain the methodology of its deployment, and to share the dipole experience. About 80 persons attended the workshop, and presentations were given by 12 MTF users. The minimum information to provide about any equipment data that will be installed in the tunnel to comply with the LHC QAP was also described. Subsequently, 22 half-day training sessions were held with about 200 participants: mainly engineers and technicians from the AT Divisions but also from the AB Division and the ATLAS experiment.

The results of the information and training campaign were immediately reflected in the increased use of the system and very considerable reduction of time and effort required from the central team for launching the MTF for a new type of equipment.

5.2 New data import mechanism

The policy to promote the direct use of MTF Web interface for registration of data as close as possible to where the data is generated has been established and accepted by certain equipment manufactures, in particular the LHC dipole cold mass assembler. However, in most of the manufacturing locations the data is collected using the MTF Excel transfer files, sent to CERN by e-mail and then imported into MTF by the EDMS Import team. With the request to import 15.000 equipment descriptions and about the same number of related documents per month, and said rate constantly increasing, the present manpower oriented tools are being reoriented to become more automatic. A new import system, called MICADO (**M**TF **I**mport **C**hain to **A**void **D**ata **O**verdose), is aiming to automate the import steps and minimize the manual interventions of the Support Team. Users will be able to submit the data directly to the import queue: an automatic e-mail will inform the user about the success of the operation or give an error report asking for correction on the data (similar to the drawing archiving).

6 CONCLUSIONS

The large scale deployment of MTF is both an organisational and technical challenge. Extensive use of the MTF in the manufacturing process of LHC dipoles provided the solid basis for the development of system features and for the formalization of the quality assurance procedures and methods. Close collaboration between the EDMS team and the different equipment groups in the initial phase of the project allowed optimisation of the tools and made it usable on the shop floor. The training and information campaigns resulted in rapid acceptance and use of the system across the project. The experience gained with the dipole manufacturing process tracking and the methods established are now applied to other complex systems (SSS, QRL) for both manufacturing and installation follow-up.

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