

FLEXIBLE APPLICATION OF THE JLAB PANSOPHY INFORMATION SYSTEM FOR PROJECT REPORTS, PROCESS MONITORING, AND R&D SAMPLE TRACKING *

Valerie Bookwalter[#], Bonnie Madre, and Charles E. Reece
 Thomas Jefferson National Accelerator Facility, Newport News, VA 23606, USA

Abstract

The use and features of the JLab SRF Institute IT system *Pansophy*^{1,2} continue to expand. In support of the cryomodule rework project for CEBAF, a full set of web-based travelers has been implemented and an integrated set of live summary reports has been created. A graphical user interface within the reports enables navigation to either higher-level summaries or drill-down to the original source data. In addition to collection of episodic data, *Pansophy* is now used to capture, coordinate, and display continuously logged process parameter that relate to technical water systems and clean room environmental conditions. In a new expansion, *Pansophy* is being used to collect and track process and analytical data sets associated with SRF material samples that are part of the surface creation, processing, and characterization R&D.

PANSOPHY OVERVIEW

This system is a custom integration of several commercial software utilities, DocuShare™, ColdFusion™, Adobe Flex™, Matlab™, Oracle™, and common desktop programs such as Microsoft Word. Users of the system range from process managers, shop-floor technicians, and test engineers to after-the-fact data miners and operations staff. The system integrates important quality assurance elements of procedural control, automated data accumulation into a secured central database, prompt and reliable data query and retrieval, and online analysis tools, all accessed by users via their platform-independent web browsers¹. *Pansophy* provides key tools for the successful pursuit of major projects such as accelerator system development and construction by offering elements of process and procedure control, data capture and review, and data mining and analysis³. This paper highlights new features in *Pansophy*, and its role in Jefferson Lab's process control and quality assurance program.

TRAVELERS AND PROCESS CONTROL

Growth

Travelers are the “basic unit” of *Pansophy* for collecting data, implementing process control, and

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[#]bookwalt@jlab.org

training. The usability of the system is illustrated by Figure 1, showing the number of travelers instantiated each year since *Pansophy*'s inception in 2000.

The most recent projects to use *Pansophy* include the “C50” rework of CEBAF cryomodules, *Renascence*, and ILC R&D. Data is collected systematically and needs to be accessed using a coherent, flexible interface.

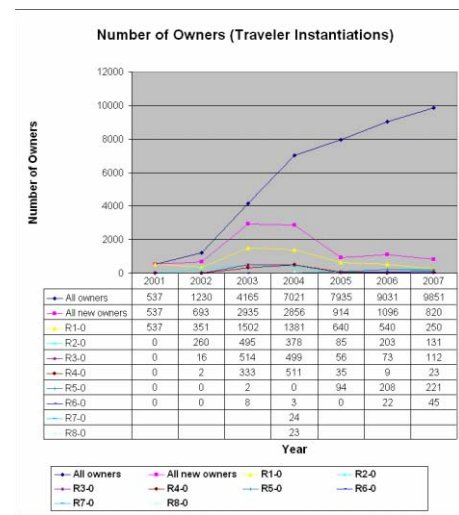


Figure 1: Pansophy statistics: Number of traveler instantiations by year.

Queries of legacy and current data

Pansophy contains cavity performance data from the original CEBAF construction circa 1992 as well as current project data and enables query and comparison of the performance of the same cavities after rework in the "C50" cryomodule re-work program.

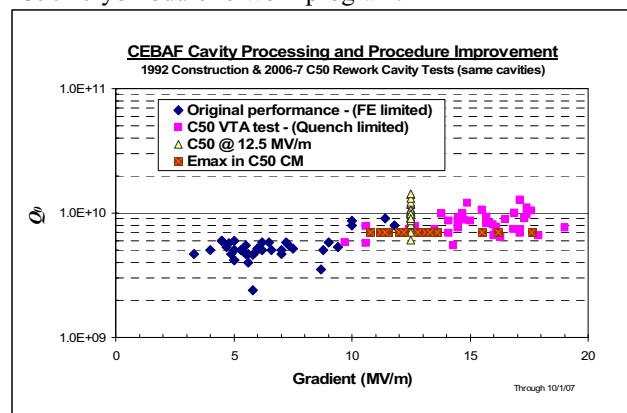


Figure 2: CEBAF Cavity Processing Comparison Chart

All queries may be exported to Excel format for convenient analysis and charting by the user. Figure 2 illustrates the performance differences for the same set of cavities prepared according to techniques current in 1992 and 2007. The C50 project data was accessed via the user-defined query utility in Pansophy. This was exported to Excel by the user for chart creation.

REPORTS

Vision and Purpose

Pansophy's design inception included not only acquisition of data but the user interaction for data mining and display. The queries offer one way of probing data for results and trends. For the C50 project an integrated set of live summary reports were built. These reports give a complete browsable and hierarchical view of cryomodule data acquired via the travelers. The data is presented to the user in an interactive graphical implementation which allows the user to drill down into more detailed reports, drill out into precise traveler data, or drill up to higher level reports. This series of reports puts data instantly at the user's fingertips and provides the tools to research all aspects of the cryomodule, from cavity performance commissioning data to which waveguide dog-leg serial number was installed in a particular location and what the results of its leak test were some time in its history.

Implementation

Built utilizing Coldfusion Components (CFCs) accessing an Oracle database, all data for the reports are gathered on demand. Fireworks, jpbs, gifs, and mouse-overs are used to create user interactions and events. These events then propagate changes to displays, pop-ups, additional screen views, drill down/up/out. They also dynamically modify screens giving users the most current information for the selected device.

User Interaction

The user can enter the C50 Reports at any level. It is not necessary to begin with the Operations Report. At each level the Oracle database is probed for the appropriate serial numbers and related traveler data which is presented to the user in a highly interactive mode.

The Operations Report gives an overview of Cryomodule (CM) Commissioning (Figure 3). Once the user selects the Cryomodule ID (CMid) the ORACLE database is gleaned for all relevant cavity id's and traveler results.



Figure 3: C50 Cryomodule Operations Report

From this point, the user can traverse to supporting traveler data or drill-down to more detailed reports on the CM. The support data includes all travelers utilized in generating the report as well as any data files uploaded to the traveler. These supporting documents include graphs, excel files, jpegs, scanned leak tests, specifications, procedures, etc. The full breadth and width of supporting data is available to the user.

From the Cryomodule Performance Report a user can drill out into the Cryomodule Assembly traveler and then see the Q_0 vs E_{acc} plot uploaded to the traveler as a pdf file (Figure 4).

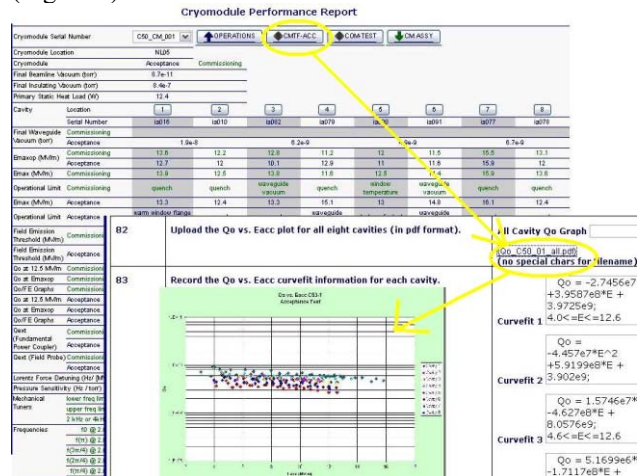


Figure 4

The Cryomodule and Cavity Pair reports are visually interactive. With mouse-over highlighting via color changes, the user is given access to all relevant travelers. Each component part gives a direct link to the specific traveler, the serial number having been gleaned from the database automatically.

The Cryomodule Assembly Report allows a user to mouse-over a section of the module, the related serial number and travelers associated with the part are highlighted. The user then has the option of clicking the part for inspection data, or selecting an option from the pull-down menu for other related traveler data. (Figure 5)

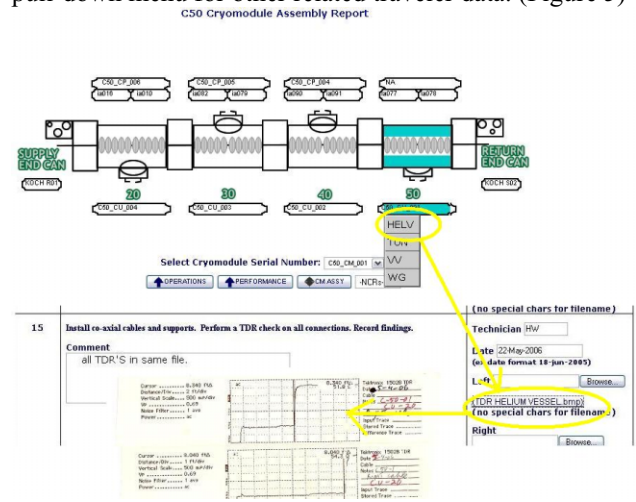


Figure 5

The Cavity Pair Assembly Traveler likewise makes use of mouse-over events. The Cavity Pair report gathers ALL travelers related to the selected pair. The serial numbers are highlighted along with the part. If a serial number is clicked the Inspection traveler for that part is displayed. If the part is selected, the assembly traveler is displayed. This includes inspections, chemical processing, assembly, welding, etc.

All part serial numbers and subsequent travelers are acquired by traversing related travelers, seeking out serial numbers, and seeking reciprocal travelers. All travelers related to the particular cavity pair assembly are found and dynamically placed into fly-out menus for convenient user access (Figure 6).

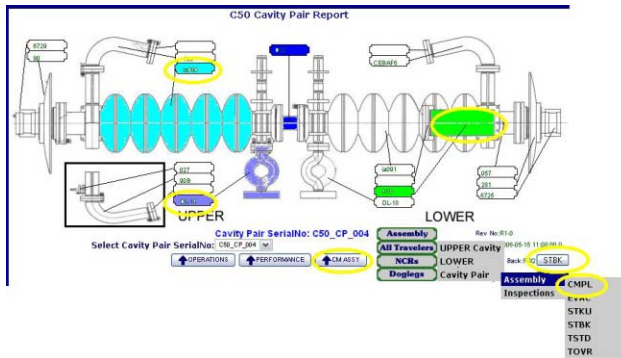


Figure 6

For example, the user could highlight the end-dish valve assembly part and click. The related traveler is displayed. That traveler then gives the user access to the leak test performed on that part. (Figure 7)

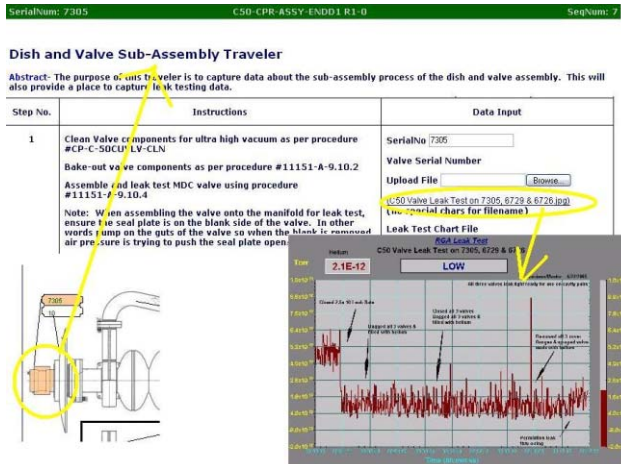


Figure 7

The VTRF Cavity Pair Report (Figure 8) shows very specific data related to the RF Testing done on the selected cavity in the Vertical Test Area. This report accepts the user input, selected cavity id, probes the database for the VTRF test associated with that cavity and finds which cavity was paired with the selected cavity by probing the assembly traveler for the serial number. The paired serial number is then used to find the VTRF test for that cavity. This allows a user to see in a single report both

RF tests for 2 cavities which were ultimately paired together during assembly.

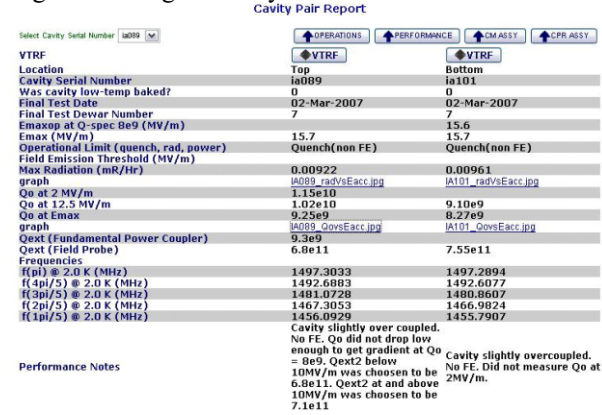


Figure 8

The report gives the user access to the original traveler data for the RF test and as a result, the user has access to the raw data, processed data, and plots. (Figure 9)

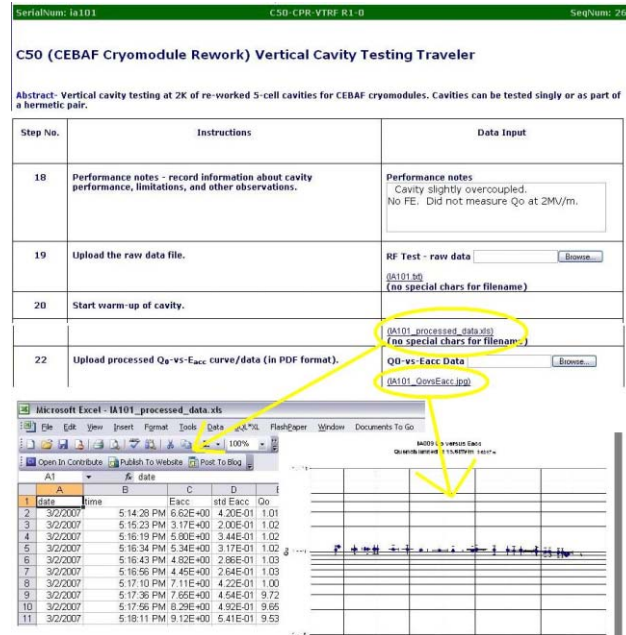


Figure 9

Results

The interactive nature of the C50 reports allows users to glean all information related to a cryomodule. This includes part inspections, weldment, leak and RF tests, chemical processing, assembly, acceptance and commissioning. The user is empowered to probe the data, seek out information, discover trends, resolve issues, and then feed back the insights learned via revisions to the travelers to continue to improve the production process.

PROCESS DATA ACCESS

Old Collection Methods

Previously, data from sensors in facilities such as cleanrooms was stored on local computers in ascii flat

files or local Excel™ spreadsheets. If examination of the data was necessary, a labor intensive process was used to prepare graphs that were then posted on a white board.

New Collection Methods

We have implemented real-time and nightly uploads of environmental data to our Oracle™ databases from LabView™ programs running in our facilities. A user interface based on Flex™ and ColdFusion™ gives users the ability to correlate conditions in the facilities with test results using a platform-independent web browser. Types of data include air and liquid particle counts, water pressure, liquid levels, etc. Users can view the data from one full day, one shift, or a user-defined time range.

Time-stamp entries in component work travelers enable direct association with contemporaneous environmental conditions that are separately monitored.

User Interaction

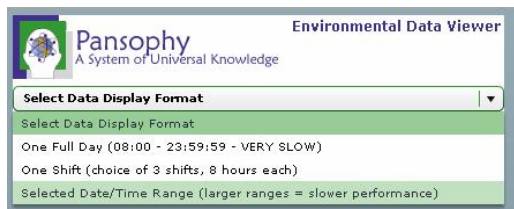


Figure 10: Main Menu for Environmental Data Access

The menu for the Environmental Data Viewer is available from the Pansophy Main Menu. The user chooses the time frame desired, and is presented with the menu in Figure 11. In this case, the choice is an arbitrary (user-defined) date and time range. The user is then presented with the menu shown in Figure 12

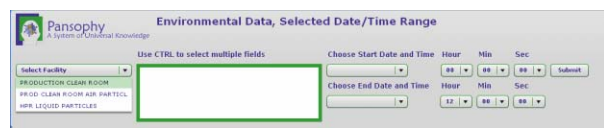


Figure 11: Selection of facility to examine

Note that a default time range is presented at startup. When the user chooses a facility (in this case, the Production Clean Room), default dates will be loaded into the start and end date fields. With most of the facilities, the default is today's date. The user can select multiple fields, using the <Ctrl> (or the <Shift>) key. Once all the selections have been made, clicking the <Submit> button will execute the query.

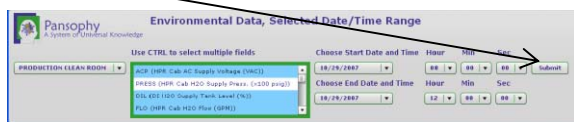


Figure 12: Select fields, dates and times

The result of the query is presented in grid and chart form, as shown in Figure 13. Mousing over the curves on the chart brings up data tips (date, time, value).

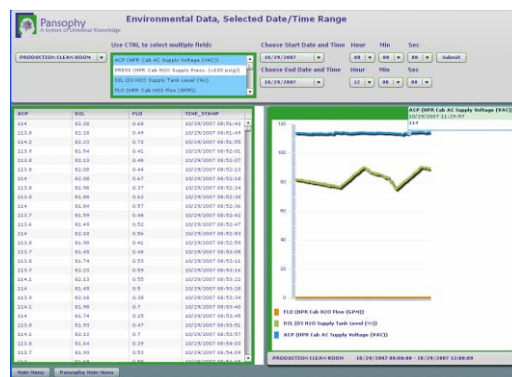


Figure 13: Query results displayed

Along with the data tips on the chart, the user can interact with the grid. The order of the columns can be changed, just by dragging the column header with the mouse. The data can be displayed in ascending or descending order, by clicking on the TIME_STAMP (x-axis) column header. This also changes the corresponding curves on the chart. If the user wants to import some or all of the data into an Excel™ spreadsheet, multiple rows of the grid may be selected using the <Shift> or <Ctrl> keys. Using the standard key combination <Ctrl>-C, the rows will be copied to the Windows Clipboard. The data may now be pasted into the spreadsheet, as shown in Figure 14.

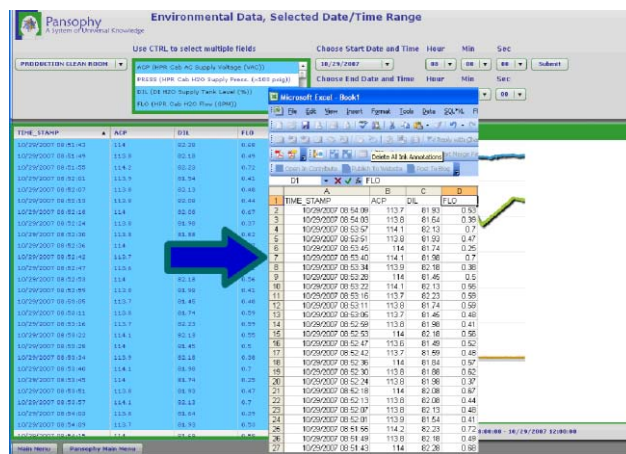


Figure 14: Data selected and imported into Excel. Time Stamp column has been formatted, and column headers added.

The data can be used to determine the conditions in the facility during construction, testing or commissioning processes in the life of an accelerator component. They can be correlated with time stamps in travelers, as shown in Figure 15.

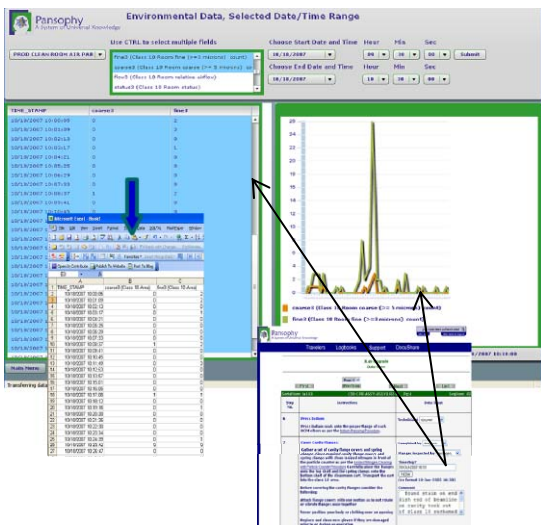


Figure 15: Correlation of Traveler data with Cleanroom Air Particle Data

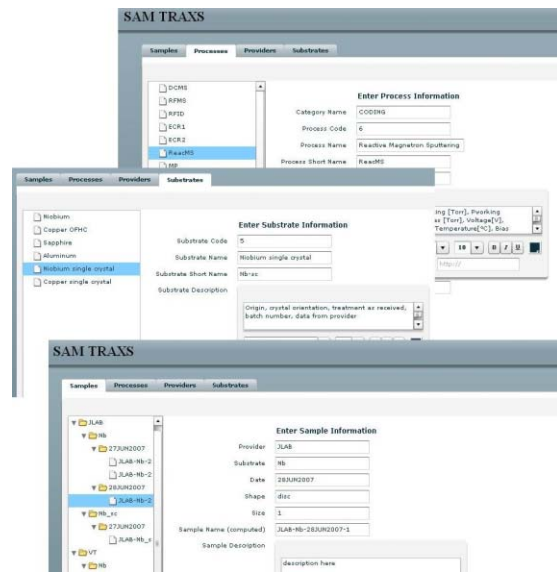


Figure 16. Initial SamTraxx screens in Pansophy

SAMPLE TRACKING

Vision and Purpose

A new application for Pansophy is its use for managing data sets associated with material R&D. Sample Tracking System (SamTraxx) is a system for collecting and organizing data associated with such material test samples. This includes data related to the acquisition of material, thin film deposition, modification, thermal or chemical processing, testing, and characterization analysis of samples utilized in R&D efforts.

The system provides for unique sample identification and collection of both systematic and arbitrary data associate with each sample. The system thus functions as a shared electronic lab notebook, with automatic robust backup.

Current Implementation

Administrative screens have been implemented in Pansophy to create both sample types and data set types. Data sets associated with a sample may either be associated with applied processes or analytical test data. Test data may be either manual entry or direct upload of data files. Flex™ and ColdFusion™ are used to provide a dynamic and intuitive user interface to data in Oracle™ databases. The system is deliberately flexible and extensible in order to accommodate evolving needs and usage.

Future

Although not presently implemented, as the quantity of sample data grows, we have the option of fielding scripted correlation analyses as the R&D efforts mature and the appropriate analyses are defined.

SUMMARY

Pansophy is by intent and design a system for handling information. As a system, it is specifically tailored to serve the needs of scientists and engineers who understand and own their processes, create the procedures, define the data of interest, and analyze the accumulating data for insights into potential improvements in process control and ultimately future performance improvement.

The recent developments in Pansophy include the implementation of hierarchical interactive reports for cryomodules and cryomodule subsystems associated with the C50 rework project, direct graphical access to logged environmental data, and an electronic database system for data sets associated with R&D material samples. Each of these, as well as the simple query and display of cavity performance data is but an example of what can be done with Pansophy.

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