ISBN: 978-3-95450-211-0 doi:10.18429/JACoW-SRF2019-THP052

PANSOPHY ENHANCEMENTS FOR SRF THROUGH COLLECTING AND ANALYZING INPUTS/OUTPUTS TO FURTHER PROJECT EFFICIENCY IN REPORTING AND PERFORMANCE*

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Abstract

SRF cavity and cryomodule testing and production requires a consistent means of collecting and analyzing data against quality and production parameters. JLab's engineering data management system, Pansophy, is utilized to assist project leaders and subject matter experts (SMEs) with such tasks, by providing a means to data mine key parameter indicators (KPI) and production planning and status data. Recent enhancements to reporting and trending have been utilized for the LCLS-II and CEBAF 12GeV upgrade projects. Further enhancements are being planned for future projects, like SNS-PPU, such as KPI trending, KPI quality, vendor quality, production timelines and user defined queries. Being able to understand past trends will assist with enhancements to future projects.

INTRODUCTION

Pansophy, JLab's SRF Engineering Data Management System, integrates several commercial software utilities, DocuShare™, Adobe ColdFusion™ Oracle™ and common desktop programs such as MS Word© and MS Excel©. The system integrates important quality elements of procedural controls, automated data accumulation into a secured central database, prompt and reliable data query and retrieval, and online analysis tools. Pansophy, is utilized to assist project leaders and Subject Matter Experts (SMEs) with such tasks as collecting and analyzing data against quality and production parameters, by providing a means to data mine key parameter indicators (KPI) and production planning and status data. Recent enhancements to reporting and trending for the LCLS-II project have guided Pansophy development (Fig. 1) and has set the stage for further enhancements for upcoming projects like SNS-PPU and LCLS-HE. This paper will describe mining of KPIs, trending of production throughput as well as project reporting.

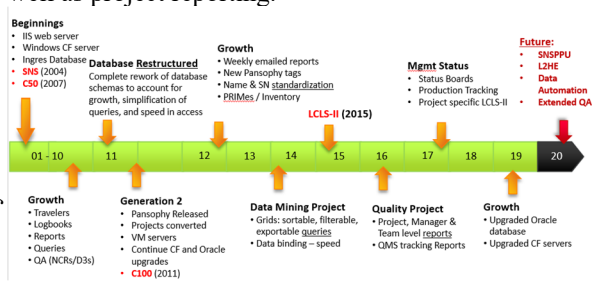

Figure 1: Pansophy development timeline.

*This material is based upon work supported by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics under contract DE-AC05-06OR23177

PROJECT REPORTING

Pansophy development started in 2000 with the first ma-jor project being SNS in 2003 (Fig. 2). Since then, it has been vital in data collection for many projects, including JLab's 12GeV upgrade (C100), C50 Refurbishment, C75 Refurbishment, and LCLS-II. This has been useful not only in collecting data for quality but also for project reporting.

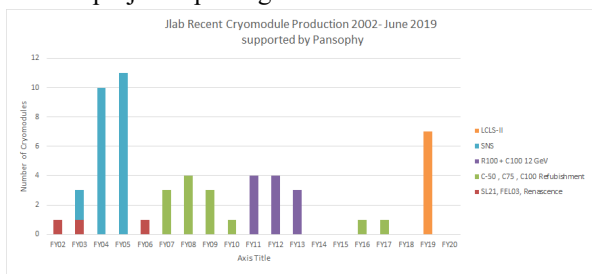

Figure 2: Pansophy use in cryomodule production.

Work Center Travelers

Focus on production throughput and meeting project schedules has prompted the development of project related queries and reports. With work center based travelers and time-stamping, project managers and SMEs can monitor progress of product inspections, non-conformance, and product availability. Work centers can show the progress of cavity qualifying and assembly progression from cavity string to cryomodule. With accurate time-stamping adjustments to priorities and workload balancing can occur.

Travelers, the base unit of Pansophy, written by SMEs in MS Word© with Visual Basic for Applications (VBA) macros aiding in the simplification of construction, allow for specifying key performance data to be collected and establish processing order and workflow time monitoring. After travelers are written and approved they are converted into web based forms. As data is collected it is secured in an Oracle database and through Pansophy's connection via ColdFusion™ based forms, mining of pre-defined reports and ad-lib user queries are possible. For example, a cryomodule status board shows the progress of cryomodule production from cavity string assembly, through cryomodule assembly work centers and shipping to customer. This status board assimilates data from multiple travelers to build a concise representation of production progress through multiple work areas (Fig. 3).

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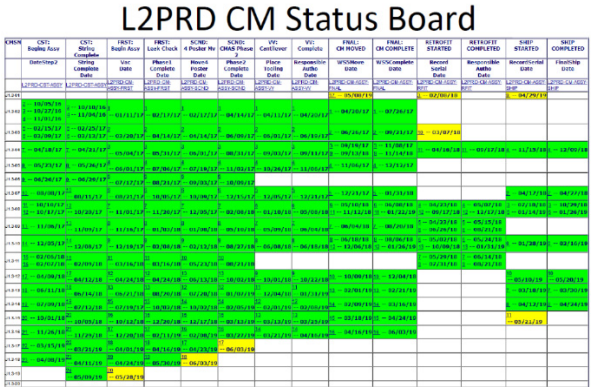

Figure 3: Cryomodule assembly status.

Travelers which are open, hence still in data collection mode, are shown in yellow, while secured data, closed travelers, are shown in green. This report gives a visual cue to project managers as to the status of data collection and monitors work center quality in securing data.

Date stamps from this report can be used to generate timelines showing work center throughput (Fig. 4) Together with work allocation specifics, work load can be modified to balance not only amount of work performed in each area, but also the amount of time required in each work center. Such studies can aid in improving overall cryomodule production schedule and quality.

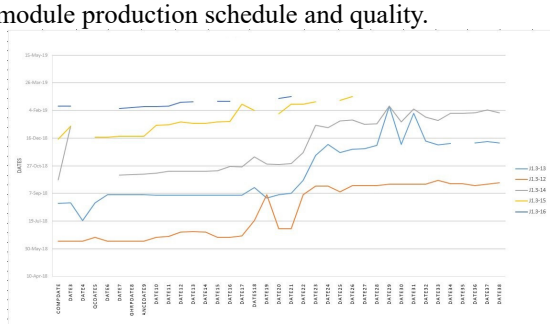

Figure 4: Cryomodule assembly work center timelines.

Vendor Supplied Data

Product quality and vendor provided data is another area to be monitored and tracked. Vendor data provided both electronically and via paper are entered into the system by the inventory management group with the use of an in-house developed software called PRIMeS. During this phase parts are identified by part number for common components and drawing number for fabricated components. All items with traceability requirements are assigned an acronym to associate the part with its serial number. When parts are received, the project code, part acronym, and serial number are uploaded into a serial number lookup table for use in select boxes in travelers. PRIMeS is the only place where serial numbers are entered by hand. Additionally any vendor supplied documents are uploaded to a receiving traveler giving full traceability for parts.

Other vendor provided data, such as hold point data collected during Cavity construction, is transferred via OneDrive and, with use of macro enabled spreadsheet workbooks, are collected and collated. The data is then transferred automatically to Pansophy in the form of a traveler. Use of templates and VBA macros simplifies and expedites this area of data collection. It also enhances quality by removing the need for user entered data, where errors might be introduced, causing data to be skewed or incorrect. As vendor cavity hold point data is collected and processed, an overview report gives visual monitoring capabilities to project managers and SMEs.

Product Quality

Non-conformance of products is another area that is monitored during the progression of a project. As parts are received, entered into PRIMeS and serial numbers transferred to Pansophy, quality control personal can access serial numbers via a select box and begin product quality checks. Quality checks may include dimensional measurements, RF tuning, leak checking and chemical processing. Each work area has traveler(s) in which the procedures and steps are defined as well as data to be collected. This data is displayed in user pre-defined reports in which time, quantity and quality parameters are monitored (Fig. 5).

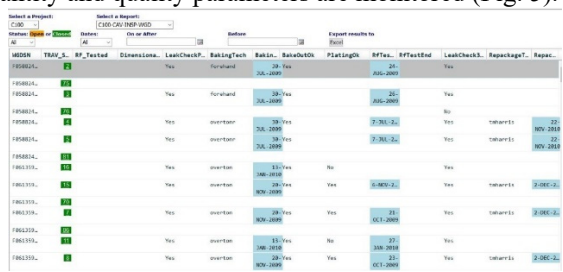

Figure 5: Waveguide inspection report.

Cryomodule Based Reporting

The LCLS-II project brought about the development of cryomodule based reporting. This can be seen in the overview report of all travelers, serial numbers, Non-Conformance Reports (NCRs), and comments compiled into a single report, nicknamed "The Traffic Light Report". This report utilizes visual cues of red and green to denote closed versus open travelers and also contains links to all travelers and related NCRs. This gives project management and quality a single point for monitoring data collected and completed. All data status is presented real-time and links provide ease of drilldown to travelers and NCRs for quick resolution of problems and/or completing data. This report also allows for the accumulation of all NCRs and commented discrepancies on a cryomodule by cryomodule bases thus assuring only qualified and document completed cryomodules are delivered to the customer (Fig. 6).

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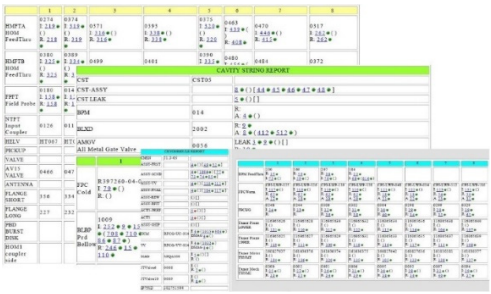

Figure 6: Cryomodule traffic report.

PERFORMANCE MONITORING

Area KPIs

With thousands of data elements being collected for individual projects, use of data mining to facilitate feedback and enhancements of production and processing activities are a high priority. Predefined reports and user defined reports assist in the data mining and analysis of key performance indicators (KPI). These include cavity processing/rinsing, serial numbers for traceability, cavity RF performance in the vertical test area (VTA), and cryomodule performance during 2K RF qualification testing.

The pre-defined reports are created utilizing template based web pages. To generate a new report only requires defining the traveler and associated variables to be retrieved. These are added via array inputs and the grid results are displayed. This style of programming has been utilized throughout Pansophy, thereby easily supporting multiple projects and ever changing data mining KPIs (Fig. 7).

Figure 7: Cavity performance KPIs.

Project KPIs

Additionally, project specific KPIs are contracted by the customer for reporting and eventual uploading to customer sites. The use of customer defined KPIs were first defined during the LCLS-II project where a spreadsheet template was defined by SLAC for transference of data. To facilitate data assimilation and prevent user introduced errors, automation of the data collection and transference was built. This includes web based reporting and VBA macros (Fig. 8).

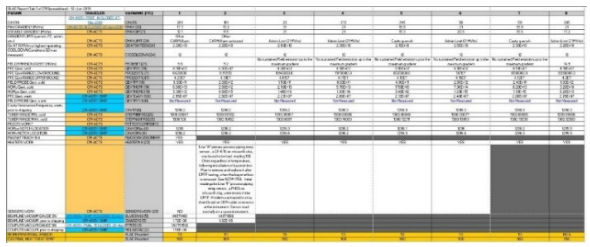

Figure 8: LCLS-II defined KPIs.

User Defined Queries

User Defined Queries (UDQ) were added early during Pansophy development. The need to be able to do ad-hoc queries of an ever expanding dataset permits exploration of many aspects of performance and production. The user can select a project, traveler, and KPIs, which can be qualified with operators and operands. A resulting data set is presented to the user, which can be exported to Excel for further analysis and graphing. This method is used to analyze such parameters as FE onset of cavity RF testing. The UDQ can be used for multiple projects to acquire the same information thereby giving a cross-project analysis of cav-ity performance (Fig. 9).

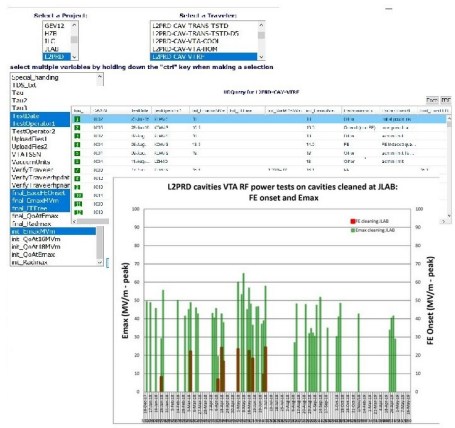

Figure 9: User defined query to retrieve KPIs.

FEEDBACK / IMPROVEMENT

Maintaining a constant flow of communication between all individuals involved in the project helps to ensure the highest level of productivity. Pansophy use gives project managers and SMEs weekly and monthly emailed reports, as well as on-demand current status of project. Feedback is also provided through pansophy datamining reports in areas of NCRs, product usability and assembly timelines.

Traveler Writing

Starting with reporting on the writing of travelers and procedures, Pansophy contains an area which produces a list of required travelers and a time-frame in which they are due to meet schedules. Managers can monitor that all authors are meeting expectations in a timely manner. If the travelers and procedures are not available in the system, the system will then not be able to function to the benefit of the quality and chemical technicians, assembly technicians and

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cavity and cryomodule testers. This up-front planning ensures a smooth transition between project planning and communication to work areas and between personnel (Fig. 10).

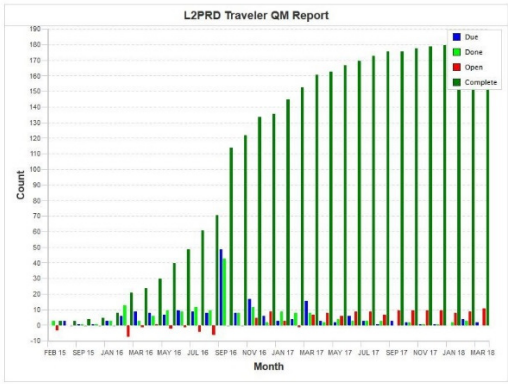

Figure 10: Traveler writing report.

Non-Conformance

Feedback, via Pansophy, is provided for vendor product conformance, timelines, and processing/testing of parts. SMEs can monitor not only the throughput but also glean important information about a vendor's product through the use of NCR reports. These reports break down the areas where most products are not meeting specifications and in which way. This information is used as feedback to project managers to confer information to the suppliers and pro-curement for use in future projects (Fig. 11).

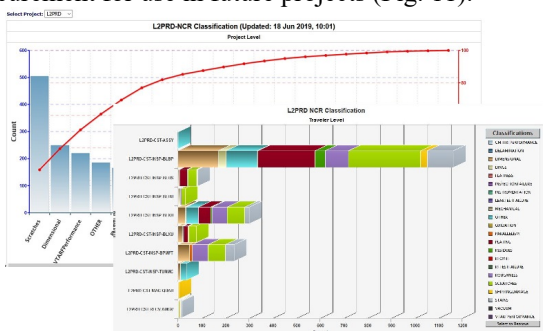

Figure 11: Pareto by Defect Type/Classification Reports

Project Lessons Learned

End of project lessons learned efforts utilize Pansophy's wide range of NCR inspection reporting and data mining to determine what, if any, adjustments need to be made in specifications, procuring or processing of acceptable parts. Lessons learned have been completed for both the SNS and 12GeV projects here at JLab [1, 2] and are in process for the LCLS-II project.

CONCLUSION

Since its inception Pansophy has continued to develop and grow with changing projects and customer requirements. Having a sound user mechanism for defining travelers and a versatile means of data-mining has continued to promote its use as we continue generating custom reporting and capabilities. Over the last 10 years, and through continuous improvement we continue to look for opportunities for improving further cryomodule product quality and also the capabilities of Pansophy. Key performance indicators are data mined from the more detailed travelers to create high level reports for the end user (Customer), for final review and approval before shipping of each cryomodule and enable team leaders and management to monitor progress of assembly and processing. Custom reports resulting from data mining are and continue to be tailored for the needs of project managers. Lessons learned, developed at the end of each project, are used to get feedback and continue the process of ongoing improvements for the next project.

ACKNOWLEDGEMENTS

* This material is based upon work supported by the U.S. Department of Energy, Office of Science, and Office of Nuclear Physics under contract DE-AC05-06OR23177

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