STATUS OF LCLS-II QA SYSTEMS COLLABORATION FOR CYROMODULE CONSTRUCTION AT TJNAF AND FNAL

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Abstract

At the Thomas Jefferson National Accelerator Facility (Jefferson Lab), we are supporting the LCLS-II Project at SLAC. The plan is to build thirty-five 1.3 GHz continuous wave cryomodules, production to be split between JLab and FNAL (Fermilab). This has required a close collaboration between the partner labs, including enhancing our existing quality systems to include this collaboration. This overview describes the current status of the Quality System development as of August 2015, when the partner labs start the assembly of the prototype cryomodules.

INTRODUCTION

Responding to a call to build a revolutionary new X-ray laser, SLAC is developing an upgrade of its Linac Coherent Light Source (LCLS) that will be at the forefront of X-ray science

The upgrade project, LCLS-II includes the design and construction of an accelerator, where Fermilab is responsible for the cryomodule design, in collaboration with JLab and SLAC.

Procurement, fabrication, assembly and test are shared by Fermilab and JLab. JLab will build 18 cryomodules and Fermilab 17. This has required a close collaboration between the labs, including enhancing our existing quality systems to support this joint construction effort.

Cryomodules (Figure 1) at both labs are being built to the same design using identical components. The end result will be cryomodules that are all mechanically identical in meeting the functional requirements.

The partner labs recognize that staff, tooling, and processes will not be identical, therefore are working on a set of common parameters that both labs will include in their production processes for reporting and comparison. Electronic travelers will be used in both labs, and as they are being developed we are sharing and comparing.

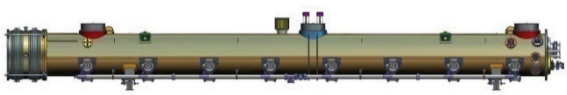

Figure 1: LCLS-II cryomodule [1].

QA staff from SLAC, JLab, and Fermilab have been working closely to coordinate quality efforts related to LCLS-II cryomodule work. All three have formal QA programs, and LCLS-II-specific QA Plans have been put in place. JLab and Fermilab QA have frequent coordination meetings (teleconference every three weeks or so with SLAC participating as necessary.) The SLAC LCLS-II QA Manager has assessed the QA programs at JLab and Fermilab (so-called "crosswalk"), and gave them both passing marks (Nov/Dec 2014). Both JLab and Fermilab are including SLAC-specific QA requirements into their plans (e.g. Acceptance Criteria Strategies), following the Graded Approach policies of both labs.

PROCUREMENT STRATEGY

Distributing procurements between the two labs minimizes administrative costs. For any given procurement, a "Lead Lab" has been identified. As the name implies, the "Lead Lab" leads and makes the procurement (i.e. procuring parts for all 35 cryomodules) while the other lab acts in a support role. The procurement strategy is described in full in the SLAC Procurement Procedure. Procurement Responsibility Matrix LCLSII-4.1-PM-0229-R0 (June2014)

As an example, Fermilab has the lead for niobium procurement; JLab has the lead for cavity & helium vessel procurement

Suppliers will ship approximately half of each order to each lab, and so each lab will perform receiving inspections on the materials they will use. This allows for each lab to work in their preferred way (to a common set of requirements), and eliminates the natural tendency to reproduce/redo work.

Each lab has named a technical person to work on each procurement (for both leading and supporting); called the Sub-contracting Officer's Technical Representative (SOTR).

The SOTR holds an important and responsible position, and is the "glue" between design, prototyping, procurement and assembly phases, while lending technical expertise for sub-system components through all phases of the project.

Design Phase

- SOTR develops technical specifications from higher level requirements.
- Prepares drawings and supporting technical documents.

Prototyping Phase

- Works with Acquisition/Procurement to procure prototypes from industry/partner labs.
- Participates in prototype development and testing.
- Feeds experience into production process.

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Production Procurement Phase

- Provides technical leadership and point of contact with suppliers.

Inspection/Assembly/Integration

- The SOTR works closely with Lead Production Engineers.
- Provides engineering expertise as needed during receiving inspection, manufacturing, and qualification/commissioning.
- Uses technical judgment to resolve product non-conformances.

QUALITY SYSTEMS

Both Labs have Lab-wide Quality Policies similarly aligned (see Table 1).

Table 1: Alignment of QA Policies

JLAB	Fermilab
JLAB QA Program Description and SRF Quality Manual	Fermilab IQA Program TD Quality Management Program
JLAB Conduct of Engineering Manual	FNAL Engineering Manual
JLAB LCLS-II Supplemental Quality Assurance Plan (SQAP)	Fermilab LCLS-II Quality Assurance Plan

DESIGN CONTROLS

The outputs of all engineering work are managed in the Teamcenter electronic database at Fermilab, to which JLab and SLAC have access. Requests for design work are formalized. Design releases are reviewed and approved using a Teamcenter™ workflow process.

Design changes that affect the functional requirements will be brought to the attention of the SLAC Change Control Board for review and approval. To ensure that consideration is given to the effects of "smaller" design changes, they will be discussed during weekly Fermilab/JLab coordination meetings and communicated to the appropriate SOTRs.

Parts and material are procured using approved drawings. Both labs pull final (approved) drawings from Teamcenter™.

INCOMING INSPECTION

All parts and materials are physically verified against shipping documents upon receipt.

The SOTRs work with QC to define inspection plans. CMMs are among the various tools available for use to inspect incoming parts (Figure 2). The two labs are comparing inspection plans and data, along with Acceptance Criteria Strategies.

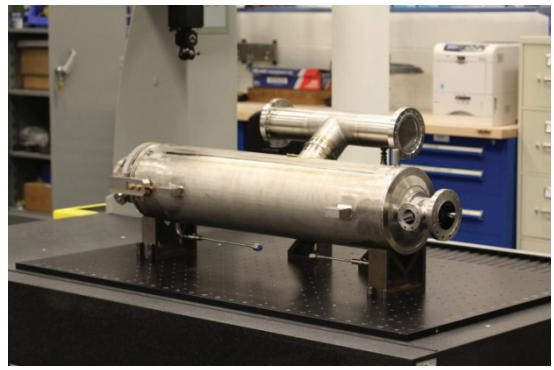

Figure 2: LCLS-II cavity/ helium vessel inspection.

PRODUCTION CONTROL, TRAVELERS AND NCRS

The LCLS-II Project has committed to using electronic Travelers which provide detailed step-by-step instructions covering the production work flow processes. Both Labs use a SQL accessible database (with different architecture of web and user interface) to generate fully electronic Travelers & procedures, replicating the functionality and flexibility of a paper Traveler.

All Travelers and Operating Procedures are under version control and any changes to those documents are reviewed and approved by responsible authorities.

The Fermilab Traveler System called *VECTOR* has open access (read only) and has been successfully used for a number of accelerator component construction projects.

The JLab Traveler system called *PANSOPHY* [2-5] has been used successfully since 2002 on large cryomodule construction projects including SNS (2002), to the more recent 12GeV (2012).

All non-conformances will be recorded using corrective action systems which are integrated with the Travelers, and have to be resolved by the SOTR or Lead Engineer before proceeding to the next step. Nonconformance reporting between the labs is expected to follow the process described in Figure 3 where communication between the labs will be through the SOTR or the Lead Production Engineer as shown.

CONCLUSION AND SUMMARY

Quality systems are in place at both labs, and have proven effective in numerous past projects. SLAC-specific requirements have been incorporated, and both systems were verified in the SLAC-led QA Cross-Walk exercises in Nov/Dec 2014.

There are on-going regular QA discussions between JLab and Fermilab on project QA. Both labs are using electronic travelers, and will be collecting a common set of parameters. Designs are controlled and accessed by all three labs through Teamcenter™. Our quality systems are in use now for the pre-production cryomodule work.

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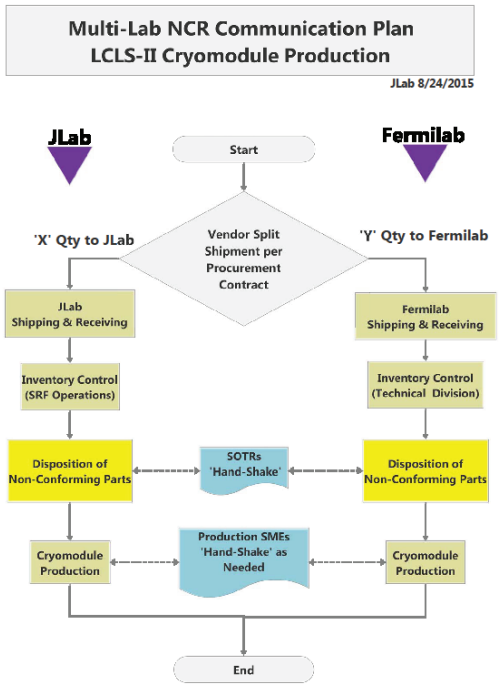

Figure 3: Multi-lab communication plan for NCRs.

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