CONTROL SYSTEMS FOR LINAC TEST FACILITIES AT FERMILAB*

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Abstract

Fermilab is constructing superconducting RF test facilities for development of technologies to be used in future linear accelerator projects. Two of these facilities, the High Intensity Neutrino Source, (HINS) and the New Muon Laboratory, (NML) are proto-type linacs which will run with beam. Originally the NML facility was primarily an R&D facility for the proposed International Linear Collider. Now both HINS and NML are focused on R&D for the Project X [2] high intensity proton linac proposed for Fermilab. The requirements for these facilities vary but all involve collaboration and flexibility for integrating various new instruments. Tight timing requirements and automation are also required. Some facilities require integration into the existing Fermilab controls system. The controls also must be robust so as not to interfere with the main purpose of the facilities. We will outline the plan for accomplishing this task as well as the current status.

STATUS AND REQUIREMENTS

HINS

HINS (High Intensity Neutrino Facility) [2] is a 60 MeV proton or H- accelerator being built in the Meson Detector Building at Fermilab. It consists of an ion source, RFQ, room temperature and superconducting RF cavities, focusing solenoids, and diagnostic instrumentation. It is initially using an instance of the SNS low level RF system [3] to control the klystron. This =and a desire to create graphical user interfaces easily without programming resulted in the decision to use EPICS for the HINS control system. The SNS LLRF system will be replaced with a new design within a year to accommodate longer pulse lengths and control multiple cavities per klystron using vector modulators.

As in any pulsed machine, it is important to be able to correlate data from the various front ends and instruments. Special time stamping which includes either pulse identification and/or synchronization across computers will be required.

NML

The NML facility is intended to test cryomodules developed for the ILC or the proposed Project X linac. Initially RF testing on a single cryomodule will be performed with no beam. Eventually the facility will support electron beam operation through 3 cryomodules at energies up to 750 MeV. The NML facility is a stand alone system which will not have to interoperate with the rest of the Fermilab complex. The low level RF system presently in use is from DESY and was developed in the DOOCs control system. There may be equipment which other laboratories may bring for testing purposes but the main objective of this facility will be the testing of the cryomodules themselves. The correlation of data by RF pulse is a requirement for NML as well.

The aggressive schedule demands that especially the cryogenic system and RF system be controllable this fall. Depending on the funding profile, beam will come somewhat later. For this reason, the Fermilab Control System will be used at NML.

There is an NML control room with operator consoles but it will most likely not be manned 24 hours per day so some oversight at least during off hours will be required.

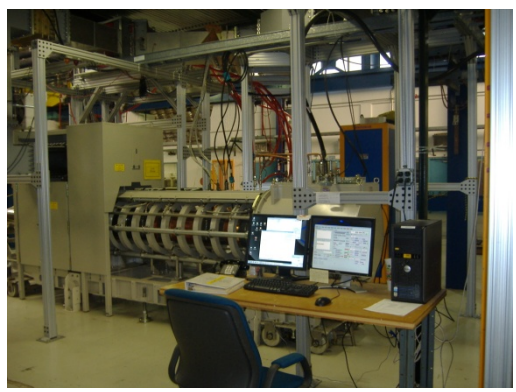

Figure 1: HINS Console and Klystron.

HTS

The Horizontal Test Stand is also in the Meson Detector Building and has been operating for the past year. The purpose of this facility is to test dressed cavities at full RF power before they are installed in cryomodules. It makes use of the DOOCs based low level RF system as well as EPICs input/output controllers for processing loops and interfacing to systems such as vacuum and high level RF interlocks and control.

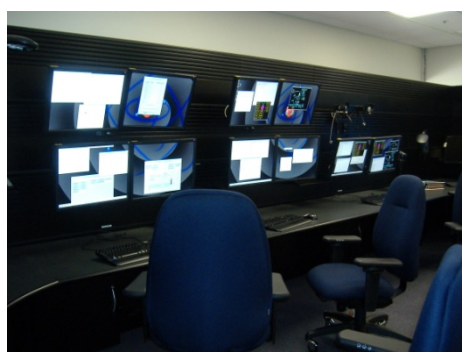

Figure 2: NML Control Room.

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Operational Considerations

From the view point of the Operations Department as well as the Controls Department, it is much preferred that one control system be used to control all of these areas rather than multiple, parallel control systems; one alarm handler, one method of data logging, one database, one graphical user interface, etc. The operations staff will be located in one location, the Accelerator Division Main Control Room.

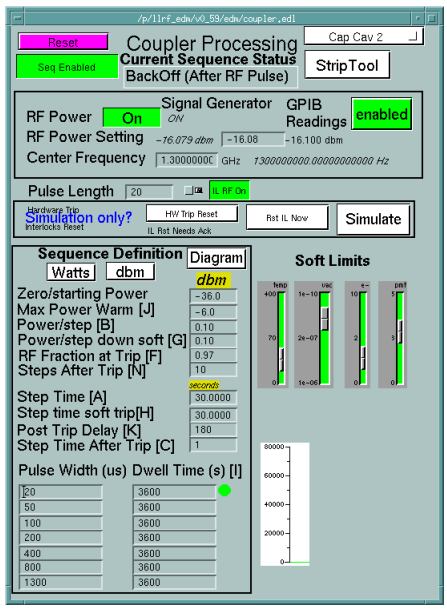

Figure 3: HTS Coupler Processing GUI

PHILOSOPHY AND GOALS

Accelerator control systems are often required to integrate disparate systems such as LabView or SCADA systems into one global, cohesive control system.

It is our preference to maintain one standard protocol within the system rather than incorporate a variety of protocols. This implies that the integration be accomplished at the lowest level possible.

The Fermilab Control System offers some facilities that are lacking in some other systems which we find extremely useful. These include most importantly, the logging of settings, the parameter page, fast time plots and snapshots, and a central device database.

There are however some aspects of other control systems which would be very useful to add to our system such as a modern graphical display builder, built in mechanisms for simple automation or PID loops, and easy to use front end builders. Extending our controls protocol to enable data correlation is also a goal.

These test areas can be the opportunity to incorporate new functionality into our system while the complex is operating without adversely affecting operation of the collider and neutrino programs.

If successful, the HINS linac may become the front end of the Project X linac. In which case, the HINS control system would need to interface with the rest of the Fermilab controls system.

Project X also is a collaborative effort which means instruments and equipment will be developed at other institutions to be integrated into the system at Fermilab. Many of these institutes already use and understand EPICS and would be more comfortable supplying EPICS drivers for their equipment. All of this implies integration of EPICS into the Fermilab control system in some fashion.

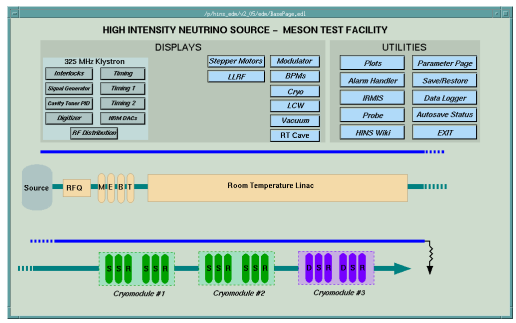

Figure 4: HINS Controls Base Page.

POSSIBLE SOLUTIONS

The TINE control system in use at DESY has solved a similar problem by incorporating a TINE task in the EPICs IOCs and DOOCs front ends [4]. We are investigating how to implement a similar approach in our system.

We have a graphical user interface builder which has been in use for some time but has functional limitations. We are increasing the functionality of our GUI builder. Also an extension for the EPICs GUI builder, edm, has been created to interface directly with the Fermilab control system protocol.

SUMMARY

Superconducting RF Test facilities at Fermilab have been run using a mix of control systems, including EPICS and DOOCS, independent of the main accelerator complex. As these efforts have become focused on R&D for the future Project X linac at Fermilab, it has become a goal to provide more commonality and interoperability between these facilities and the main Fermilab control system. It is planned to support EPICS IOCs and selected tools in the main system for cases where that may be the appropriate choice for some subsystem. These facilities will provide a test bed for the future Project X linac control system.

ACKNOWLEDGEMENTS

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