Review Slides Text 9907

This is the essence of the slides from the July Project Review and the text that accompanies the slides.

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ALS Superbend Controls

Requirements and Design

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Controls in Project
- Superbend Power Supply Controls
- Superbend Magnet Monitoring
- Superbend Cryosystem Monitoring
- QFA Quadrupole Controls
- QDA Quadrupole Controls

The controls content of the superbend project includes controls for the new superbend magnet power supplies, diagnostic monitoring for the cryosystems and magnet, and controls for the new and repowered quadrupole magnet supplies.

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Requirements Categories
- Standard
- Evolutionary
- New

I've divided the requirements into three categories. Standard requirements are the same ones we have always had for ALS. Evolutionary are new but only slightly different than what has gone before. New requirements are substantially different from previous and represent increased risk to schedule and cost.

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Standard Requirements
- Safety, Equipment protection
- Reliability, maintainability
- 10 hz readout & control rates
- Ramping not controls-limited
- Compatibility with existing applications
- Utilize off the shelf, Standards

The standard requirements are the ones that the ALS was built with, so we must follow for compatibility. Safety and Equipment protection must, as always, not be subject to the potential failures of Controls hardware and software.

The reliability and maintainability of the controls must meet the high needs of the accelerator. With beam life of 4 hours (soon to go to 12?) it is important to avoid interruptions of the system by any source, and the controls must abide by this. In event of a failure the time to diagnose and repair should be relatively short and it should be possible for the staff on hand to accomplish the task with minimal coaching from the development staff (who may be home asleep at the time).

We need to meet the long established 10 hz readout and control rates.

It is important that the ramping rates not be controls limited.

Insofar as meaningful, the new systems should be compatible with the existing software applications.

Wherever practical commercial hardware and software is to be employed.

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Evolutionary Requirements
- Using Compact PCI
  - developed for controls expansion, upgrade
  - already in use on Third Harmonic Cavity
- Settable Ramping Rate Control
  - existing ramping rates are static

The evolutionary requirements represent a small change from the existing work we have done. Compact PCI hardware has been developed as an expansion and upgrade path for legacy controls. This equipment has been installed in the Third Harmonic Cavity system. Only small changes to this existing design are planned for this project.

The power supply controls existing in the Legacy Controls have ramp rates that are relatively static. They can be changed only by recompiling and reloading software. Smooth ramping of the machine is difficult because these parameters must be selected for some average situation and not tailored to the actual ramp in use. It is planned to make these ramps adjustable and we'll start with the new systems in Superbend.

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New Requirements
- Resolution, Settability
  - 1 part in 60,000
- Stability and Noise
  - 1 part in 60,000 longterm
  - 1 part in 200,000 short term

The New requirements imposed by the Superbend Controls are stiff based on the physics requirements for beam location and stability. This led us to consider a digital interface to the supplies since routing analog signals of this type between systems is problematic and might lead to difficulty fixing the source of problems. With a digital interface it is up to the supply (one vendor) to perform once the command has been digitially sent.

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Power Supply Review
- suggested using 18 bit DAC

validated our proposal to use embedded controller in supply

A review of the power supply for the Superbend was held (date tbd) prior to the procurement going to the vendor. Action items from the review included moving to a 18 bit DAC (exceeding our 1:60000 requirement slightly) and using digital controls to the supply.

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SB Supply Controls Design

- 18 bit dac (existing design)
- Embedded PLC in supply
  - commercial hardware
- Standard Field Bus interface
  - DeviceNet (superset of CANBus)
- 10 hz control/readout
  - 50 hz loop, ramping step

The Superbend power supply vendor has an existing 18 bit design that exceeds our requirements at reasonable cost, we have specified that. They proposed an Allen Bradley embedded PLC in the design to implement the required DeviceNet. We chose devicenet after some research and discussion with others in the controls business. The DeviceNet consortium, led by Allen Bradley, has many hundreds of manufacturers, and many products are available. Our choice was not solely for the Superbend project, as we are seeking standards for access to I/O for many future projects and DeviceNet appears to meet that need.

The 10 hz readout and control is the standard capability of the ALS control system, so we require it here even though the Superbends cannot respond that quickly.

The 50 hz ramp rate was proposed by an AB engineer and our PLC programmer indicated this was a typical looping rate for a PLC of this type. The ramp step will make small cumulative changes to the DAC input according to the ramp rate set into the control registers. This will facilitate smooth ramping. As other magnet controls are upgraded they will all have the additional capability to set the ramp rate dynamically.

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Scope of New

- DeviceNet
  - use commercial hardware and software
  - start this early
- PLC embedded software
  - work with vendor, get sourcecode
- Superconducting / Cryo User Interfacing
  - Alarm issues

To minimize the risk of delay associated with the unknown (to us) DeviceNet interfacing we are starting this work early (already). We will use commercial hardware and software for most of this effort, but it will require some software to interface with our EPICS based controls core. The developer is scheduled for training and we are proceeding to procure a DeviceNet Bus Analyzer to shorten our development times.

The PLC embedded software will be handled by the power supply vendor. They will supply us with sourcecode but we do not plan to work at that level. We will work with the vendor to avoid surprises in the delivered system.

The User Interface will consist of a new application for the Superbends that folds the available controls information into one set of displays. There are many channels and relating them in a custom display is the most effective way for operations to work with them. Alarms are under discussion. Temperature trends could be alarmed since detection precedes beam loss and notification could be used to take action that could preclude beam loss.

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ALS Control System with Superbends Diagram

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end part I, start part II

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ALS Superbend Controls

Scope, Schedule, Cost

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Controls Scope of Work

- Step cPCI I/O card, chassis
- Superbend Power Supply Controls
- Superbend Diagnostic Controls
- Quadrupole Controls
- Control Room Application
- Systems Integration

The scope of controls work in the Superbend project includes work in six areas shown here. The actual I/O card is a slightly improved model of the one developed for Controls Expansion and Upgrades that is currently employed in the Third Harmonic Cavity system. The changes are primarily adding a serial eeprom memory to store calibration information onboard. This work is already underway. Parts procurement has begun even before the design changes are complete due to the lead times involved and the small design changes planned.

The superbend power supply controls will be a joint effort between us and the power supply vendor. This contract is already out, and we have already begun developing our end of the DeviceNet interface. We expect to work closely with the vendor as he ramps up the PLC programming.

Superbend diagnostics include standard analog and digital inputs and outputs, and GPIB I/O. The one new item is the fast data acquision for cryo monitoring. A number of channels will be monitored into a circular buffer 1024 in size at 1 to 10 hz. Receipt of a post-trigger will stop the data collection and subsequent readout will display trends immediately prior to the event.

Quadrupole controls are conventional for the control system but this will be the first time we have controlled quads with the new control hardware. Some software that currently exists on the ILC will have to be converted to run in the cPCI.

A Superbend Control Room Application is planned that will integrate the channels into coherent operator and engineering displays in the control room. Alarms are under discussion that would alert operations staff to dangerous trends in the cryo temperatures long before they endangered the stored beam in the machine.

Systems Integration is an important and significant piece of work that is always required to effectively commission the hardware and software.

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Schedule Chart

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Controls Cost Summary

Superbend Project Funded	
controls hardware	47k
controls software	31k
Controls Upgrade Funded (AIP)	
devicenet development	30k
hardware development	15k

Funding for the Controls portions of the Superbend Project comes from several sources. The portions of the work that are directly related to the Superbend are funded from the project, in the amount of an estimated 78k. The development related work that is not directly tied to Superbend controls is funded from the Accelerator Improvement Program, and is shown at 45k in this estimate.

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end part II