U.S. DEPARTMENT OF ENERGY JSA

SoLID Slow Controls

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Summary

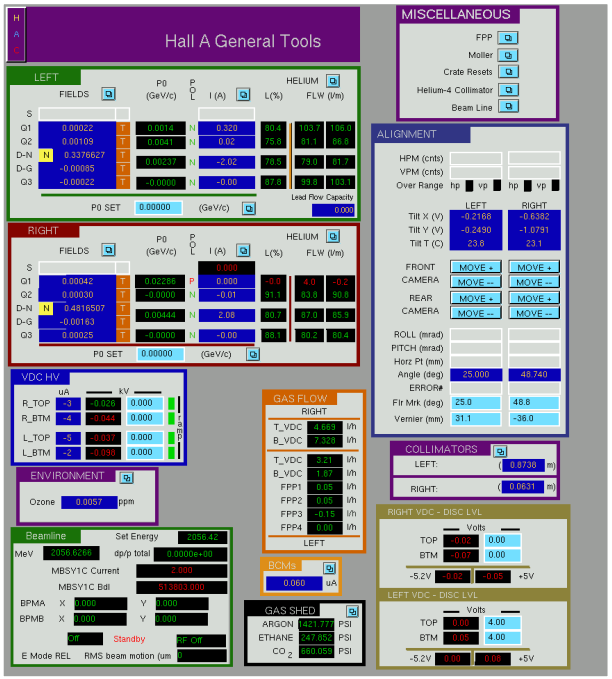
- Slow controls for project on this scale is significant
  - Hall B → 2+ FTE (professionals) for ~2 years (6 people made significant contributions)
- Think about and document slow control needs
  - Feed your requirements/design specs to <brads@jlab.org>
    - I'm happy to support research and answer questions
  - Everything will be more $$$ and more complicated than you may expect...
- Standardize, standardize, standardize
  - Avoid investing time in 'quick' solutions for local implementation. Stick with the standards – steeper learning curve, but it'll save time in the long run (build trained people as well as software).
  - Hacks and workarounds tend to become 'permanent' and unintended dependencies get baked in – good to avoid these.
  - Proper hardware selection will minimize custom IOC/PLC development.
- EPICS should be our common API/Protocol
- Frontend GUIs/software take time and $$ to develop
  - Control Systems Studio (CSS) framework is recommended
  - Software maintainability is *at least* as important as features/functions

Detectors – General Requirements

- HV / LV controls, Temperature, Pressure GUIs with EPICS compatible logging (and alarms)
  - Appropriate crate selection makes this straight forward. Recommended systems have control, monitoring and alarm loops already implemented, no IOC/PLC development needed.
- LED Gain monitoring ("on/off") remote controls are straight forward
- "Flow-through" / open-loop gas systems (GEM, LGC)
  - Solved problem with pre-existing GUIs. Go with a standard MFC, etc.
- Heavy Gas Cerenkov gas system
  - Infrastructure can be complex, but slow controls are minimal since fills are done manually (and rarely) by an expert, then system is sealed during production.
  - Just needs online monitoring of pressures, temps—fairly straight forward
- Only "fast" interlock that crosses (sub-)system boundary is to trip HV if GEM flow stops. Straight forward with recommended HV systems.

Frontend GUIs

- EDM (MEDM) / JTABS

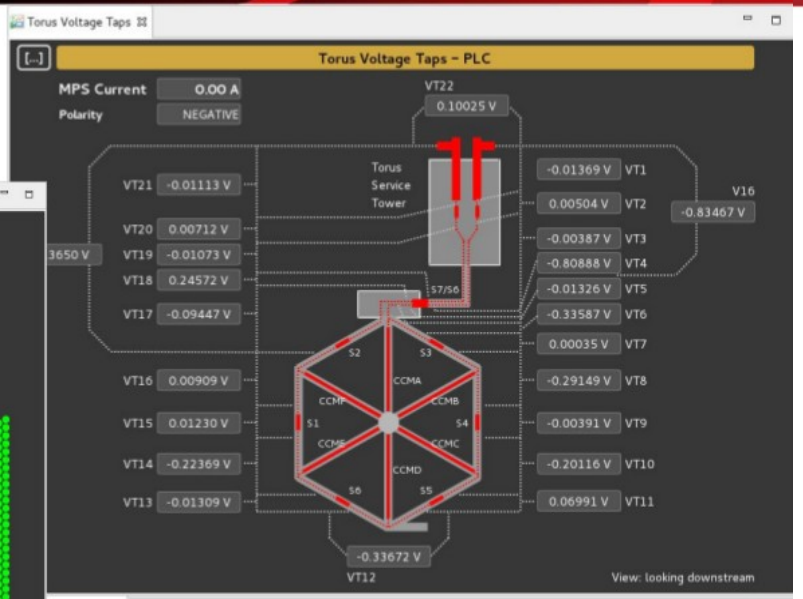


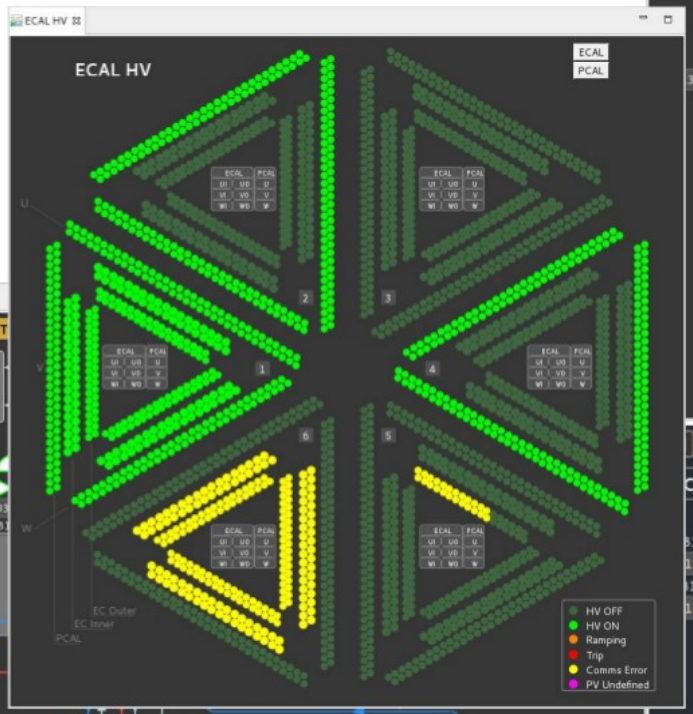
  - Forward-port of JLab's 6 GeV EPICS screens
  - Still developed, but dated
- Control Systems Studio
  - http://controlsystemstudio.org/
  - Eclipse-based toolkit designed for systems like ours
    - SNS, BNL, FRIB, DESY using this system
    - JLab: Hall D (in use), Hall B (in use), Hall C (in use)
  - Now migrating to Phoebus (replacing Eclipse UI framework; same idea)
- Will enforce standards across systems
  - Avoid LabView
  - Avoid custom/proprietary code as much as possible
    - if not possible, provide EPICS interface for integration

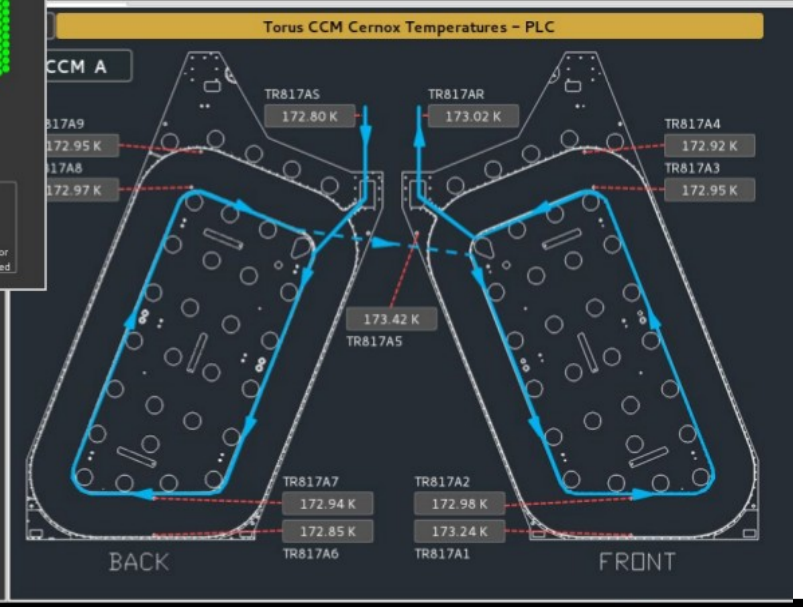
CS-Studio

GUIs a combination of:

- Script generation, internal and external to CSS
- Image overlays
- Hand drawn







Slow Controls System Overview

Detector	HV / LV Power	LED flasher/ pulser	DAQ Crate Monitoring/ Control	Gas System Type	Temp Monitoring	Flow	Pressure	Fast Interlock	Comments
GEMs	x		x	Flow through		x		x	75/25 Ar:CO2 mix; HV interlock w/ flow
LA/FA SPD	x	x	x						
ECal	x	x	x						
Light Gas Cerenkov	x	x	x	Flow through		x			1 atm(abs); CO2, N2
Heavy Gas Cerenkov	x	x	x	Fill & Seal	x	x	x		1.5–1.7 atm(abs) C4F10 or similar

Summary (Slow Controls)

- Even with component standards enforced, and fairly modest requirements, slow controls for project on this scale is still significant
  - Hall B → 2+ FTE (professionals) for ~2 years (6 people made significant contributions)
- Standardization and cross-system oversight is critical prior to purchase to avoid issues
  - Direct/Authoritative oversight by CAM?
  - Ensure EPICS and other low level interface support is present and to spec
  - Avoid home-built and proprietary software where possible
  - Identify and communicate system needs that may cross sub-system boundaries
  - EPICS will be our common API/Protocol
- Maintainable Frontend GUIs/software require sufficient time *and* professional software developers
  - Control Systems Studio (CSS) / Pheobus framework is recommendation

Backup Slides

EPICS

- Experimental Physics and Industrial Control System
  - http://www.aps.anl.gov/epics/
    - Open source, actively developed, lots of users
    - Based on C; APIs available for Java, Python, LabView, etc...
  - Covers both input/output controllers (IOCs) that do the real work
    - *ie*. poll for and respond to data in real time
    - publish data for other systems to consume
    - IOCs can be single board computers running vxWorks, embedded devices that supprt the EPICS protocols, or 'softIOCs' which are applications that can run under conventional OSes (linux, etc)
- Main slow controls 'backend' used at JLab
  - A lot of expertise in Accel Div. that we can leverage
    - However, we need to schedule (and budget for) the developer time well in advance!
  - Archiving of slow controls data can be integrated with existing (Accel) MYA Archiver