Experience on SNS Beam Instrumentation Collaborations

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Outline

SNS Instrumentation Collaboration

- Time-line
- Setup with partner labs (hand-off documents)
- Issues/Comments

Much of this is how I experienced this collaboration! Different people have different experiences.
Instrumentation Collaboration Phases

Start

• Conceptual Design Report (1998 ~CD2)
  o Type and number of instruments, platform was VME&VXI (NAD?)
  o Accelerator Groups have defined responsibilities
    - Controls: MPS/PPS/Networking/Archiver/Vacuum/Cryo
    - Physics: Physics Applications (design and implementation-> XAL)

• Memorandum Of Understanding -> Project approved and money available to partner labs
  o At this point there were three independent BPMs to measure almost identical beam, Front-end, Linac, HEBT (402.5Mhz) same with BCM etc, because the work distribution to partner labs was by linac segment

• Up to construction part (CD3) there were project-wide collaboration meetings. Small ORNL-based SNS team (managers/designers)
• (CD3+, 1999-2000) Partner labs use their expertise and people to design and implement. SNS team manages more aspects through central authority.
SNS Control System

ICS

ORNL

Internet

File Servers
App Servers
Database

Office

Field

Timing

MPS

VME

NAD

PLC

Controllers

Accelerator Equipment
SNS Instrumentation

Definition of the interface. One such document is the ICD (Interface Control Document):

- Defines the capabilities
- Defines the environment

Interface:

- MPS
- Timing
- Network
- Signal
- Power/Cooling
SNS Instrumentation

Ion Source
- 2.5 MeV
- 87 MeV
- 186 MeV
- 387 MeV
- 1000 MeV

Ion Source

RFQ

DTL

CCL

SRF, $\beta = 0.61$

SRF, $\beta = 0.81$

HEBT

RTBT

Target

BPM #160
BLM #370 (30 IOCs)
BCM (Diff BCM) #26
ChuMPS (MEBT) #1
Laserwire (SCL) #10
Electron Scanner (Ring) #2
Spark Detector (LEBT) #2
Residual Gas Analyzer (FE)#2
Laser Emittance (HEBT)
Ion Profile Monitor (Ring)
Idemp
Electron Cloud Detector

Harp (RTBT) #1
Wire Scanners (Linac/RTBT/HEBT) #42
Video Screens (Injection/RTBT) # 5
Energy Degrader Faraday Cups (DTL/CCL) #6
Aperture (MEBT) #1
Beamstop (MEBT/CCL) #2
Bunch Shape Monitors (CCL/HEBT) #6
Allison & Harp Emittance Scanner (FE/MEBT) #3

Pulse Train
Accumulation
Short Pulse

ProjectX 11/21-22 2008
Collaboration Documents

- **Design documents**
  - Naming conventions
  - Physics requirements

- **System brochure**
  - Physics requirements & engineering specs

- **Interface Control Document**
  - Mostly EPICS Interface

- **Traveler/Acceptance**
  - Hand-off document
Collaboration Documents

ICD

Acceptance Criteria
Collaboration Documents

Acceptance test
Collaboration Documents

Diagnostics Document Server (for now)

There also is An Official Document Server but this is hard to use. A front-end to it is being developed.
Collaboration Phases

Built-up

• Instrumentation now an organizational group (one person, mid-2000):
  o Merged instrumentation designs (commonality PCR with $3M savings)
  o Continued collaboration meetings on instrumentation
  o Instrumentation implementation not dependent on other groups
    o interface at box with controls
    o software and hardware done by Instrumentation Group & Partners
  o Platform down-selection: PC-based NAD versus Linux NAD versus VME -> PC-based chosen for most but must be integrated with EPICS (large array support, hardware timestamps)
• Reviews: a lot of them and also referred to as relentless but provided feedback and action items to rally around:
  o Diagnostic Advisory Committee started by SNS Group Leader
  o DOE/ASAC reviews
Collaboration Phases

Built-up (2000-2004)

• SNS builds local team:
  o Starting from scratch, there is no SNS Old (there was an ORNL neutron reactor and ORNL people)
  o People from other labs, diverse ideas (we did this much better at our lab, fill out your favorite lab here). But no local history among groups
  o Accelerator Groups have defined responsibilities

• Expansion of local facilities
  o receive and evaluate prototypes
  o build/test local infra-structure
Collaboration Phases

Run-up to commissioning (2004-2006)

• Integrate instruments (integration is owned by local team)
  o enforce programming style (modify delivered software)
  o add local controls protocol to instruments (EPICS)
  o create instrumentation console screens (EDM)
• Change in requirements, readjust budgets, renegotiate with partner labs
• Installation ramp-up (add technicians)
• Move to accelerator site
• Reviews continuing (4x per year), readiness reviews
Collaboration Phases

Commissioning (2006)
- Verify integration with network, MPS, PPS, timing
- Visits from partner lab experts (several hired)
- Reviews continuing (4x per year), readiness reviews per commissioning phase
- Switch to laser profile system in superconducting linac
- Implement additional systems not in the budget before: SNS Channels, Emittance Scanners, and others
Commissioning

~ 2 years

650 kW
Commissioning

- Early commissioning campaigns helped integration of new systems (controls, timing, diagnostics, software applications, ...)
- Less time was available for latter stages than originally planned
Collaboration Phases

Post Commissioning (2006-Now)

• Still doing documentation
• New developments, e.g. to add instrumentation that was cut:
  o Ring profile: Electron scanner/IPM
  o Laser Emittance
  o MEBT Scrapers
  o Differential current monitors
  o Capacitive current monitors
• Redesign of instrumentation to performance and ease of maintenance
• Lots of new safety/operational rules that increase inertia:
  • Work orders
  • Administrative restrictions: CCR call-in
  • Project development rules
Instrumentation in progress

Existing instruments

- **Reliability**
  - became critical for ops
- **User friendliness**
  - non-experts to operate
- **Additional capabilities**
  - filtering
  - beam accounting
- **Obsolescence**
  - parts no longer available

New instruments

- **Unexpected issues**
  - RGA Monitors, Spark Detectors
- **Physics Requests**
  (Non-interceptive/high intensity)
  - Electron Scanner
  - Ion Profile Monitor
  - Laser Emittance
  - Damper for e/p
- **Operations (Safety)**
  - Loss decay
  - Differential Current Monitor
  - 60 Hz Beam Accounting
Collaboration Issues

Issues and comments

• How to figure out if some instrument development is going too slow or in the wrong direction.
  o Progress reports: not clear what is going on
  o Visit by manager: nope, need local expert to meet with partner lab expert

• Technical Corrective mechanisms: (Up to pulling the plug and always painful)
  o Review committees
  o Obvious failing of prototypes
  o Requires very good working relationship (it is not just internal)

• Budget:
  o Years away from CD4 it is great, closer to CD4 it sucks
  o Conventional Facilities can eat up budget
  o Your budget will get cut
  o Need significant contingency (25% at SNS) to absorb the unexpected not only in your own area but also from others
Collaboration

Issues and comments

• One lab had dedicated group to work on SNS related work, this prevented a priority conflict between work at partner lab versus work for SNS.

• Budget cuts on travel decreased communication at the most critical moment, i.e. last year.

• Collaboration is less efficient than one lab, but good to jump-start large projects:
  o Figure out responsibilities and accountabilities and corrective mechanisms ahead of time and count on change
  o Retaining key people as the partner lab role end
  o Collaborators can help fill the staffing bubble

• Working with other labs, while tedious at times, is a lot of fun:
  o Get to know other people
  o Get to see how work is done at other labs
  o Expand your horizon