CSNS Controls Plan

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http://gcsns.ihep.ac.cn/

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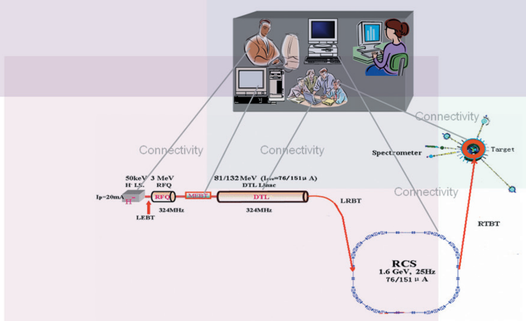
China Spallation Neutron Source (CSNS)

Outline

- Overview
  - Control Scope/Task and Architecture
- Technical design
  - System Design, Choice and Debates
  - Issues,Challenges, Progress
- R&D
  - R&D scope,Issues,Progress
- Summary

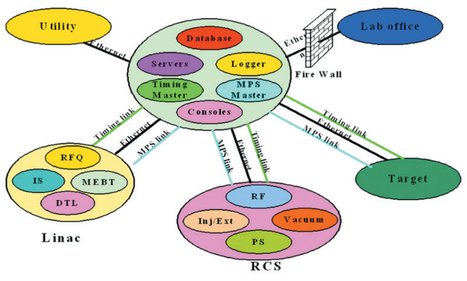
CSNS Facility and Controls



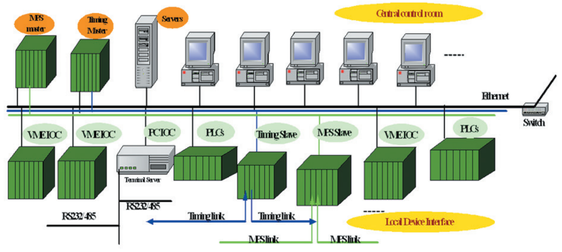
Control Task

- Provide synchronization operation (Linac/RCS/Target)
- Provide equipment fast protection (Linac/RCS/Target)
- Provide the connection between operators and accelerator equipment.
- Provide the connection between programs and accelerator equipment.
- Provide the connection between operators and conventional facility/personnel protection system/target and Experiment Area.

Control Distribution Layout



Integrated Control System Architecture



System design,choices

- Control Room
  - Servers(PC/Linux):
    - IOC boot servers(2), File servers(2), Archiver server(2), Physics Application Servers(4),Domain Servers(2)
  - Console: Human machine interface(OPI)(20~30))
    - EDM/Web-based OPI on PC/Linux/Windows
    - Big Display Screen (5~10)
  - Master MPS/PPS/Timing racks
- Machine Physics Applications
  - XAL core and Eclipse platform
  - Machine function display
  - COD(closed orbit distortion)
  - Beam loss monitors

System Design(Cont.)

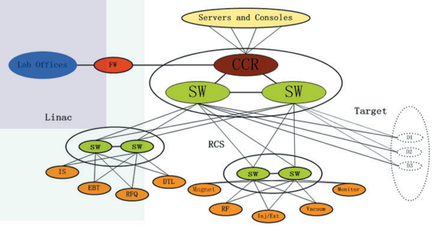
- Database
- Static DB(Oracle)
  - Magnet measurement DB
  - Survey/Alignment DB
  - Configuration database(device manager)
    - Stores configuration parameters
      - Channel/device name, constants, calibration, I/O address,etc
  - Snapshot database(MPS DB)
    - Stores the state(all settings) of the machine
  - Historic database
    - Logs data over long periods of time
- Dynamic DB(created by VDCT/SNS JERI)
  - EPICS IOC DB(real-time DB)

System Design(Cont.)

- Network(10/100MEthernet)
  - Connect computers to front end devices
  - Effective management of traffic and security
  - EPICS CA gateway for the different subnet EPICS IOC database access

CSNS Control Network Configuration

- Core Switch: redundant
- Edge Switch



System Design(Cont.)

- Linac Control System
  - Ion Source/LEBT/RFQ/MEBT/DTL/Beam Instrumentations
  - Vacuum Control/Monitor
- RCS Control System
  - Injection/Extraction PS Control
  - RCS PS Control
  - RF Control
  - Vacuum Control/Monitor
- Target/Experiment Area Control
  - Target Protection/ Neutron choppers timing Synchrotron
  - Beam product info. monitor

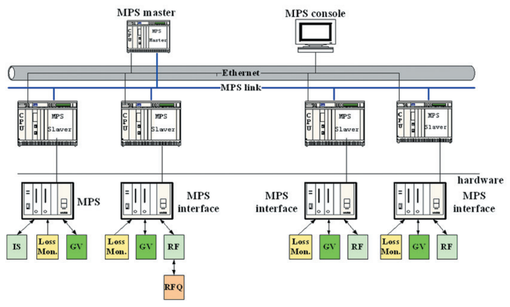
Machine Protection System(Global)

- Depend on the type of the machine
  - Beam power,pulse length
  - CSNS beam power:120kw/240kw
  - CSNS pulse length at target:0.8 μ sec (short pulse)
- The common requirements to MPS:
  - Protect beam apertures and insert devices from damage
  - Minimize radiation produced by the beam
  - Used as an accelerator diagnostic
    - Trigger data acquisition when a fault occurs,start post mortem application automatically
  - Tight integration with timing(Not simple interlock)
  - MPS signal is transferred by redundant optical fiber cables
  - Availability > 99%

MPS interface

- Magnet PS
  - Over Voltage/Over Current/PS Faults
  - Water Cooling OverTemp./Coil OverTemp.
- Collimators
- Beam Dump
- RFQ/RF
- Vacuum
  - Valves
- Beam Loss Monitor
- Target (TPS)

MPS (Global)



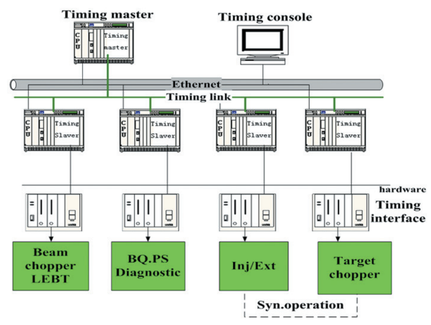
MPS (Global)

- A hardware-based "fast protect" system
  - Turns off the injector and dumps the beam whatever something wrong happens with devices or radiation dose over limit
- A routine interlock system provided by PLCs
  - Permits injection pulse-by-pulse
- A software-based "run-permit" system (by IOCs)
  - Compares the accelerator state with the operator selected running mode before injection

Timing(global)

- Provides synchrotron pulses to subsystems
  - linac,RCS Inj/Ext,PS,RF,Diagnostics……
  - extraction syn. to neutron choppers
- Reside in every VME IOC
- Three signals
  - RF clock: CSNS 10MHz
  - 25Hz clock
  - Events

Timing (Global)



Issues, challenges

- Informal Review on CSNS Controls/Data Acquisition/Beam diagnostics was held on March 5.
- Control cover:
- Linac, RCS, Target/Experiment Area, MPS/PPS,Timing, Conventional Facility
- Collaboration between the control and other groups
  - Link man(subsystem responsible person), regular meeting, write note
  - Make clear detail requirements and make interface definition
  - Lack of man power
- Global System very important
  - MPS/TPS hardware interface circuits need to be developed.
  - Timing logic need to define
  - Less experience/lack of experts—need consulting some experts.

Progress

- Ion Source Control Interface Definition(finished)
  - PSC/PSI for ion source high voltage PS control
  - YOGOYAWA PLCs for Vacuum Control/Interlock
- Injection/Extraction Interface Definition(finished)
  - YOGOYAWA PLCs/WE7000 for Injection/Extraction PS control
  - LeCroy oscilloscopes for Extraction PS waveform monitor
- Vacuum Control Interface Definition(finished)
  - YOGOYAWA PLCs for Vacuum Pump/Valve Control/Monitor/Interlock
  - Digi serial port server for Gauge controller via RS232/485
- RFQ/RF Control Interface(to be decided)
  - RF LLRF will adopt digital LLRF based on PMC-FPAG.
  - EPICS Software Interface to LLRF(by the control)

Progress

- Linac/RCS PS Standard Interface(to be decided)
  - PS group is developing DPSCM(PWM regulation)
  - All PS are digital PS. Digital interface to digital PS
  - Three options in discussion
- MPS/TPS/PPS/Timing Interface(to be decided)
  - MPS interface to the Linac/RCS
  - MPS response time need to be decided
  - TPS interface need closely collaboration with the target
  - Need to customize MPS hardware integrated with timing
  - Plan to collaborate with domestic company

Software Progress

- Adopt EPICS to setup CSNS control framework
  - A control system "toolkit" developed at LANL and Argonne
  - EPICS 3.14.9 PC/Linux development platform
  - VxWorks 6.2
- XAL(SNS) installed(finished)
  - How to install XAL manual in Chinese
  - Help manual for XAL in Chinese
- Separate SNS specific codes from present XAL release.
- Implement CSNS specific beam line devices by extending XAL devices (to be done)
- Improve and create new codes(to be done)
- Set up source version control system – CSV

Database Progress in CSNS

- Analyze SNS DB schema(done)
  - Magnets,diagnostics,PS,magnet measurement,global coordinates,Jeri,MPS,E-logbook…
  - Getting start with magnet measurement
    - Modify magnet measurement tables to match CSNS magnet measurement requirement
    - Design a standard interface to magnet measurement data
    - Magnet measurement team provide data file in Excel
    - …..
- Design the CSNS global database – consults SNS(to be done)
- Early DB Start is good for CSNS project quality management
  - Use in Magnet & Survey
  - Use in Equipment
  - Use in XAL and Control System

R&D Scope

- Setup Application Development Environment(ADE)
  - Real-Time ADE(EPICS3.14.9 & Vxworks6.2)
  - PC/Linux(CVS master)
    - /csns/epics
    - /csns/dev
- PS Control Prototype（digital interface)
  - VMEcrate based on ModBus/TCP/UDP interface+Laptop (low cost)
  - Embedded EPICS digital controller (high cost)
  - VME IOC+ PSCN（high cost)
  - Solution Discussion is underway
    - Compare advantage/disadvantage(labor/cost/time)
    - Make a final decision

R&D Scope

- Ion-Source Control Prototype
- MPS Prototype- PMC-MPS integrated with timing
- Timing Prototype
- Database Schemes prototype
  - Using barcode for magnet/PS/.. Cabling number
  - Stores info of the magnet/PS/.. Cabling
  - Developing user input interface
- Control R&D (2007.5- 2008.12)

Summary

- Control System Philosophy Design already done
- Some device control interfaces have been defined.
- Some requirements to the devices are not yet clear, the CSNS control team need times to discuss with the device group about the control interface to those devices.
- Control Prototype in the development
- CSNS will attempt to standardise on all vacuum and power supplies which will facilitate the controls task.
- The site construction of the project will start in 2008.
- The site has been chosen to be at Dongguan in Guangdong province.
- R&D work will be done in IHEP.
- Beam commission is planned to start in 2012.