Overview

• The process
• Major user requirements
• Architecture
• Major technical choices
• Infrastructure requirements
  – location
  – technical services
  – control system services
  – communications
• Plans for installation and commissioning
• Milestones for the work
• Conclusion

The electrical network

• Substations, distribution and power lines
  – HV substations
  – MV substations
  – LV distribution systems
  – The power lines connecting them
• The equipment
  – Breakers on all voltage levels
  – Transformers on all voltage levels
  – UPS systems
  – Battery chargers
  – Process control devices, etc., etc.
• The dimension
  – Lots of equipment…
  – Yearly consumption: 1000 GWh
• Process variables
  – 100,000 input channels

The HV-MV network
Some user requirements…

• Remote monitoring of equipment states
  – Status lists of electrical equipment
  – Synoptic diagrams - single line diagrams
  – Alarm lists

• Data recording for analysis
  – Events, status changes
  – Measurement states

• Process control (local or centralized)
  – Automatic procedures via standard languages
  – High-level procedures without programming

Architecture

• Centralized
  – SCADA applications
  – Configuration and logging databases
  – Web services

• Distributed
  – Data acquisition interfaces (front ends)
  – Serial lines to equipment – field-buses

• Electronic equipment interfaces
  – Digital input
  – Analogue input via transducers (limited usage)
  – Output

Integration

• CERN data exchange
  – Follows ST divisional principles
  – Centralized interface via TDS
  – Data types: States, measurements, CAS alarms, output

• Communication and networks
  – Technical (services) network (128.142…) - essential!
  – Dedicated optical lines to critical equipment

• Terminals/User interfaces
  – X terminals (substations, TCR, offices, BAs)
  – New SPS PC terminals
  – Web interface
Data acquisition - localization

Hardware and OS

- Server systems
  - HP (Digital, Compaq)
  - OS: Tru64 Unix
- Data acquisition
  - Intel PC Industrial computer ("rugged") – 48V DC (battery)
  - OS: Windows NT
  - AB/CO VME Front End for special purposes
  - OS: LynxOS
- Equipment interfaces
  - Data Acquisition Units with input/output cards
  - CERN PLCs (Schneider)

Main servers

Software

- Server systems
  - UNIX SCADA for electrical distribution
  - Databases
    - Oracle for logging
    - Ingres for configuration
  - Services
    - Web access for logging (Apache/PHP)
- Data acquisition systems
  - PC SCADA for electrical equipment and substation automation
  - Drivers adapted for CERN electrical equipment (+20 protocols!)
- Integration with CERN data exchange
  - DDAL TDS equipment controller
Substation data acquisition

Communication - exchange

- TDS integration
  - Standard DDAL API
- Database servers
  - Oracle ODBC drivers
- Distributed data acquisition systems
  - IEC standard protocol over TCP/IP
- Field buses
  - Standard field buses: Modbus/JBUS (RS-485 support)
  - Dedicated Field bus for I/O interfaces: LonWorks
  - Some electrical equipment with private “field buses”!
  - Software gateways possible in special cases

Infrastructure requirements

- Reliable power supply
  - 48V for substation equipment (data acquisition)
  - UPS for communication equipment
  - UPS for servers and computing infrastructure
- Communications network
  - High availability
  - Secure networks
  - No specific bandwidth requirement

Planning - milestones

- SPS
  - Partial installation (no complete SPS renovation yet)
  - BA4 completed, BA7 planned for 2003
  - SPS electrical renovation not yet funded
- LHC
  - Surface buildings completed by September 2003
  - Underground not yet started – limited installation
  - Some LEP equipment still operational in alcoves!
- Meyrin
  - Planned for shutdown 2003-2004
Outstanding issues

- Experimental control and supervision
  - Expensive revamping of LEP distribution
  - Expensive controls cabling for supervision
  - Project under way with first experiment
- LHC supervision
  - Data exchange infrastructure in place but...
  - Exact configuration of data required not fixed
  - Need to validate implementation (speed, etc.)
- LHC data logging
  - Exact data definition not yet finalized

Conclusion

- Progress
  - Electrical equipment defined, in installation
  - Controls hardware and infrastructure in place
  - Controls software still open for development
  - Operational experience already accumulated
  - Potential outstanding issues to fix before 2005
- More information?
  - http://st-div.web.cern.ch/st-div/groups/el/el.htm

Last slide

Thank you!
- More information?
- Questions?
- Or go directly to
  - http://st-div.web.cern.ch/st-div/groups/el/el.htm