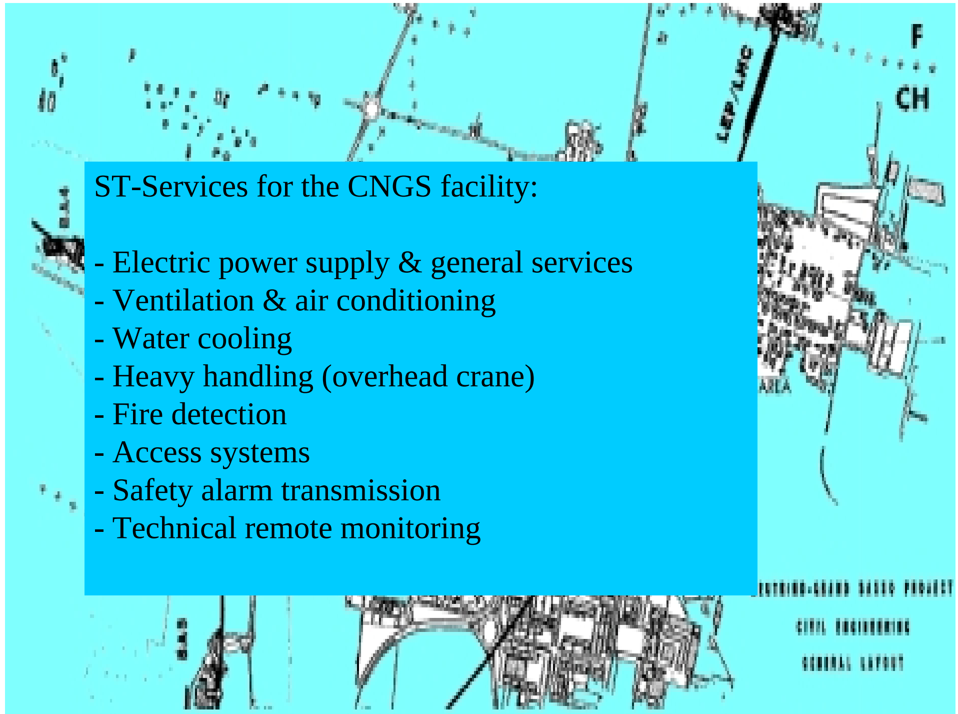
CNGS & LTI from the "ST" side...

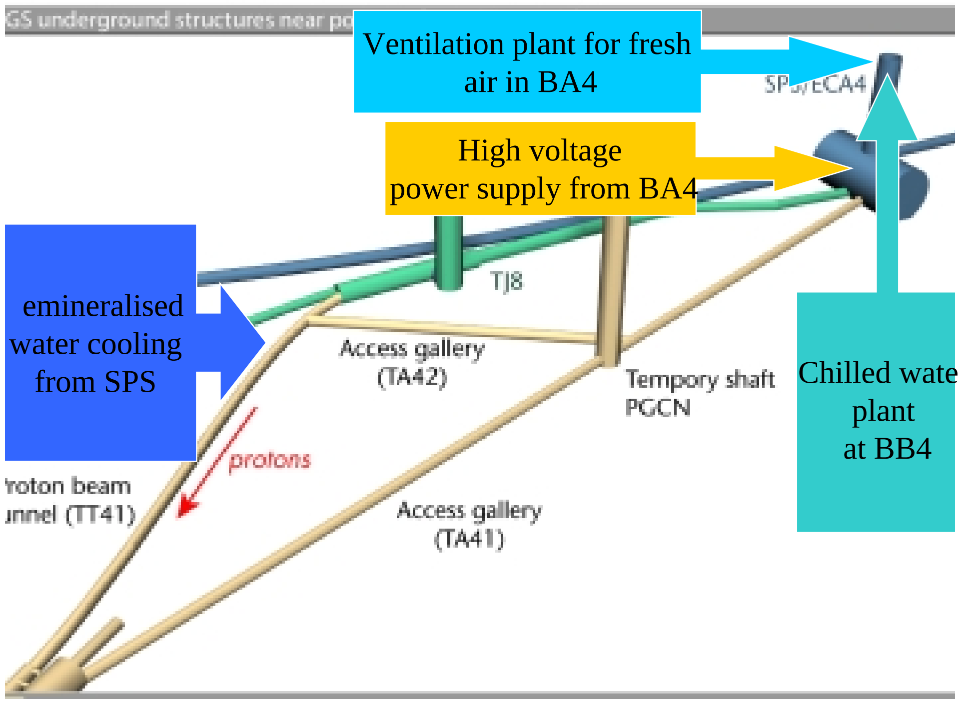
Outline:

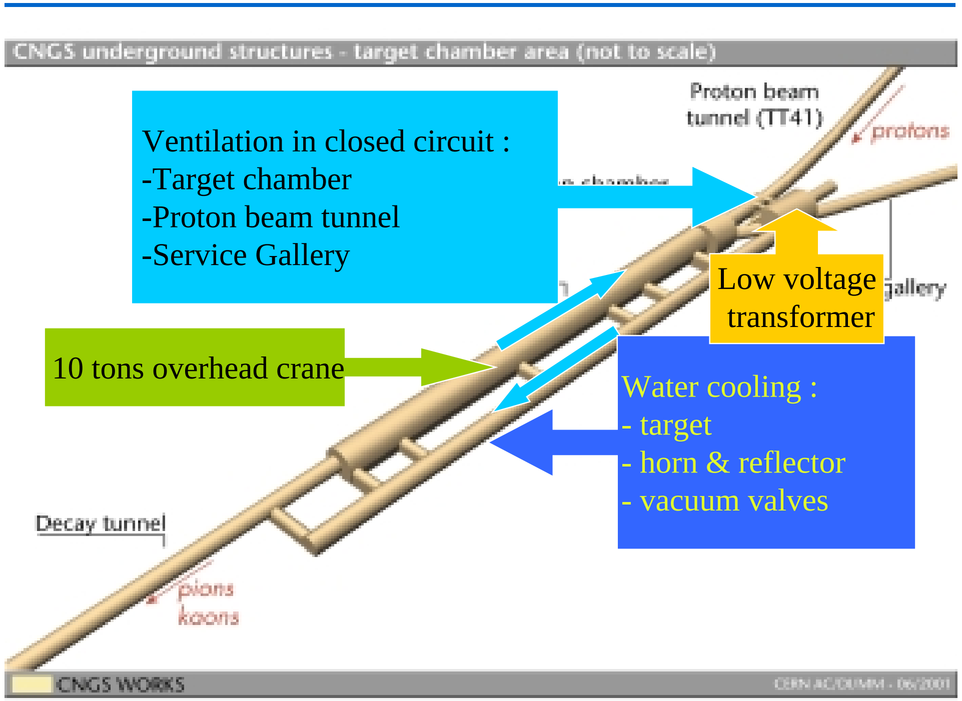
- ST activity
- Equipment groups control systems
- Integration in Control Rooms
- Operation

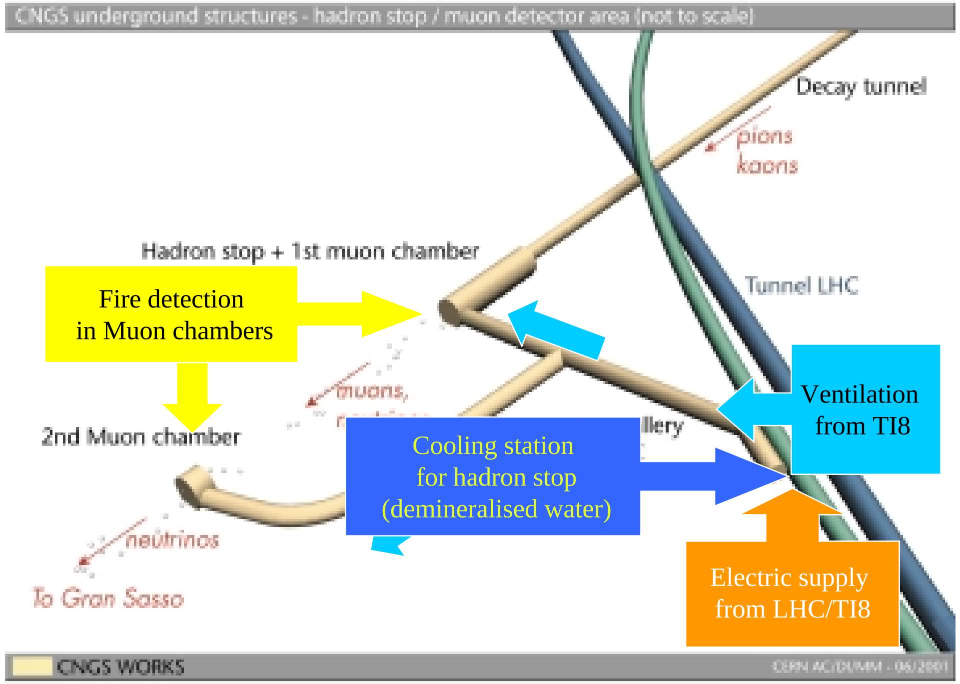


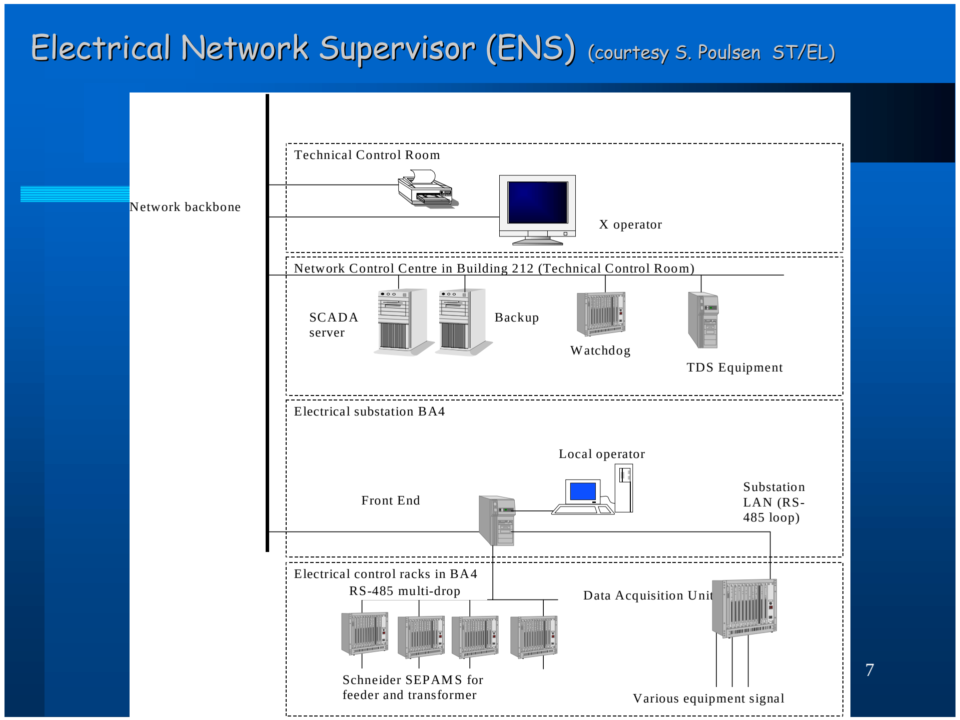
ST-Services for the CNGS facility:

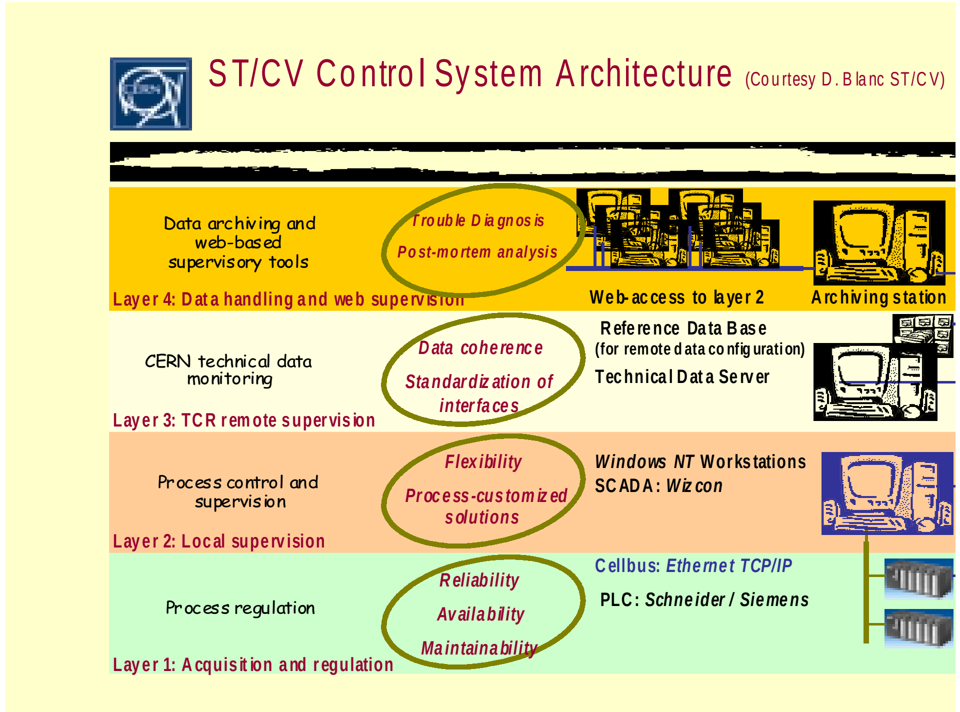
- Electric power supply & general services
- Ventilation & air conditioning
- Water cooling
- Heavy handling (overhead crane)
- Fire detection
- Access systems
- Safety alarm transmission
- Technical remote monitoring

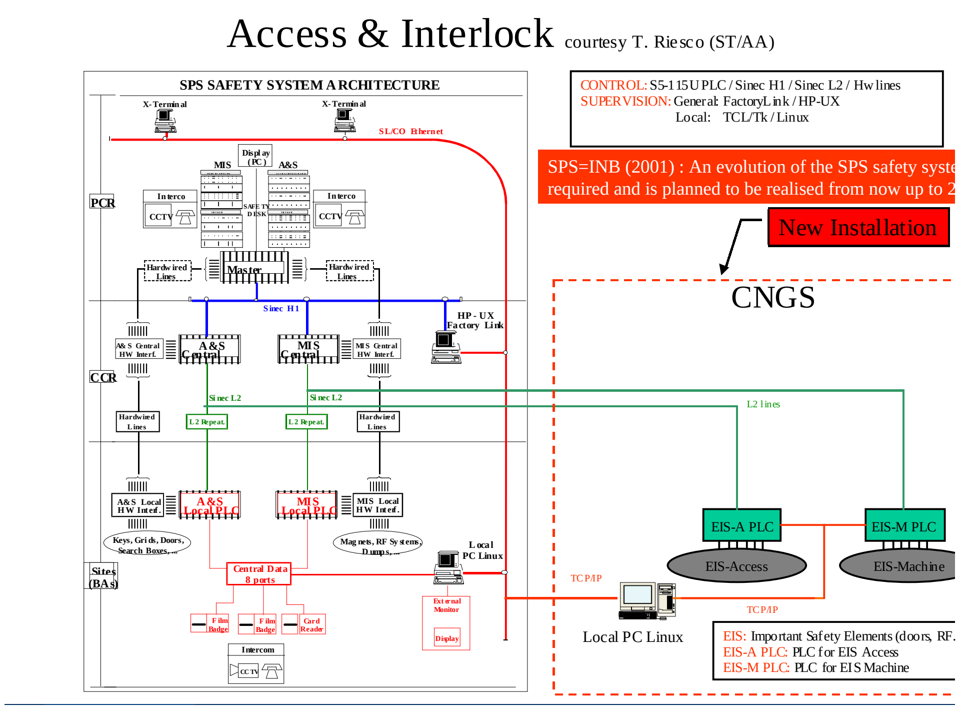


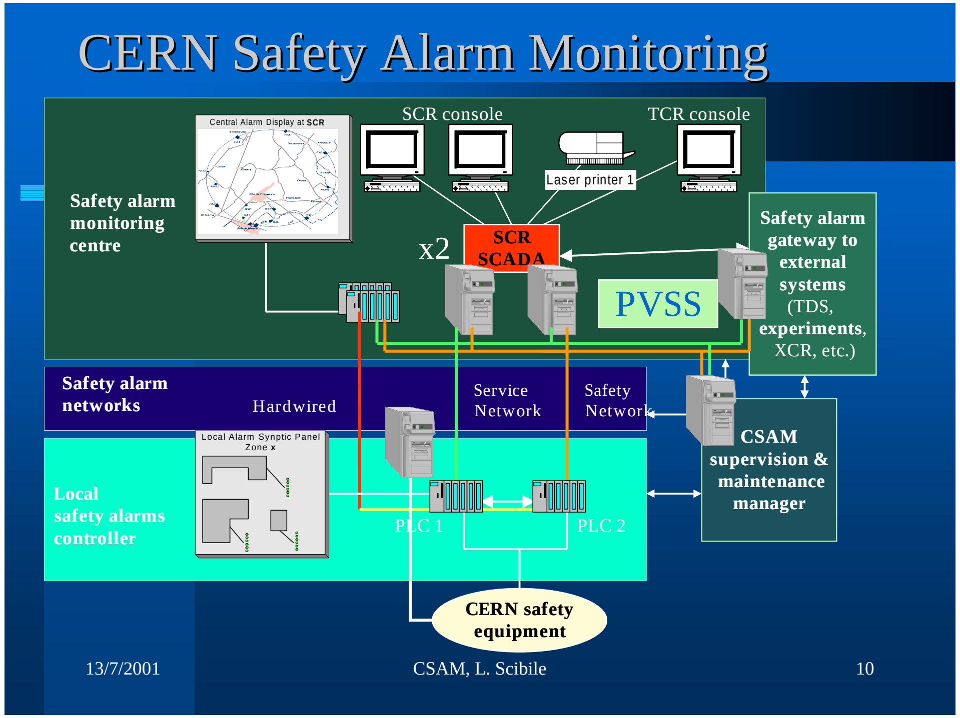

CNGS underground structures - target chamber area (not to scale)
Proton beam tunnel (TT41)
protons
Ventilation in closed circuit :
-Target chamber
-Proton beam tunnel
-Service Gallery
Low voltage transformer
10 tons overhead crane
Water cooling :
- target
- horn & reflector
- vacuum valves
Decay tunnel
pions
kaons
CNGS WORKS
CERN AC/DI/MM - 06/2001

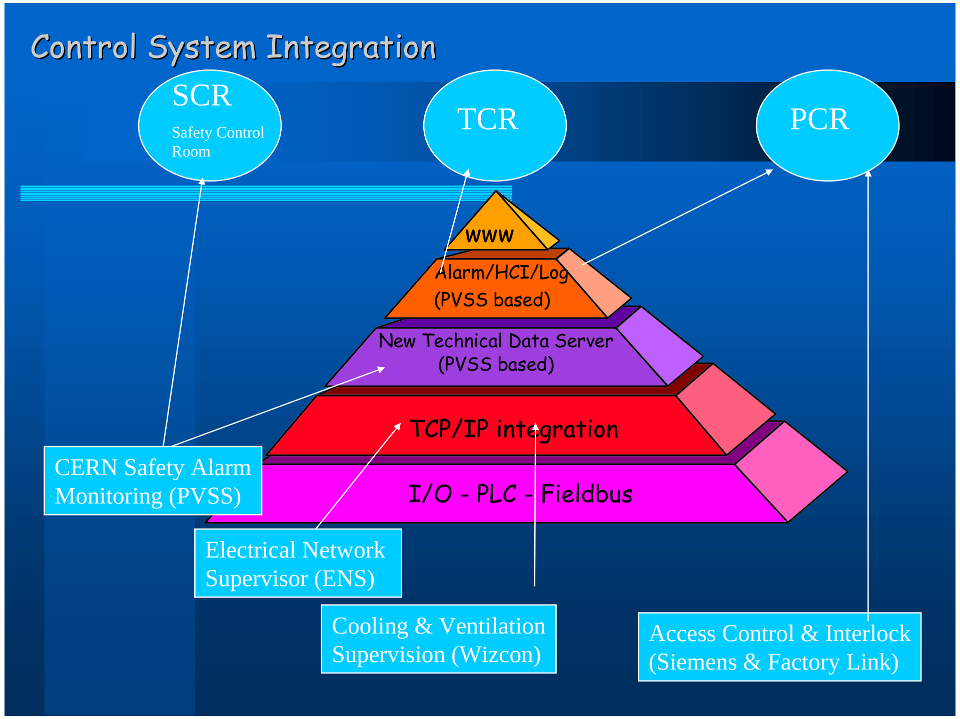

CNGS underground structures - hadron stop / muon detector area (not to scale)
Decay tunnel
pions
kaons
Hadron stop + 1st muon chamber
Fire detection
in Muon chambers
Tunnel LHC
Ventilation
from TI8
2nd Muon chamber
muons,
Cooling station
for hadron stop
(demineralised water)
neutrinos
To Gran Sasso
Electric supply
from LHC/TI8
CNGS WORKS
CERN AC/DI/MM - 06/2001

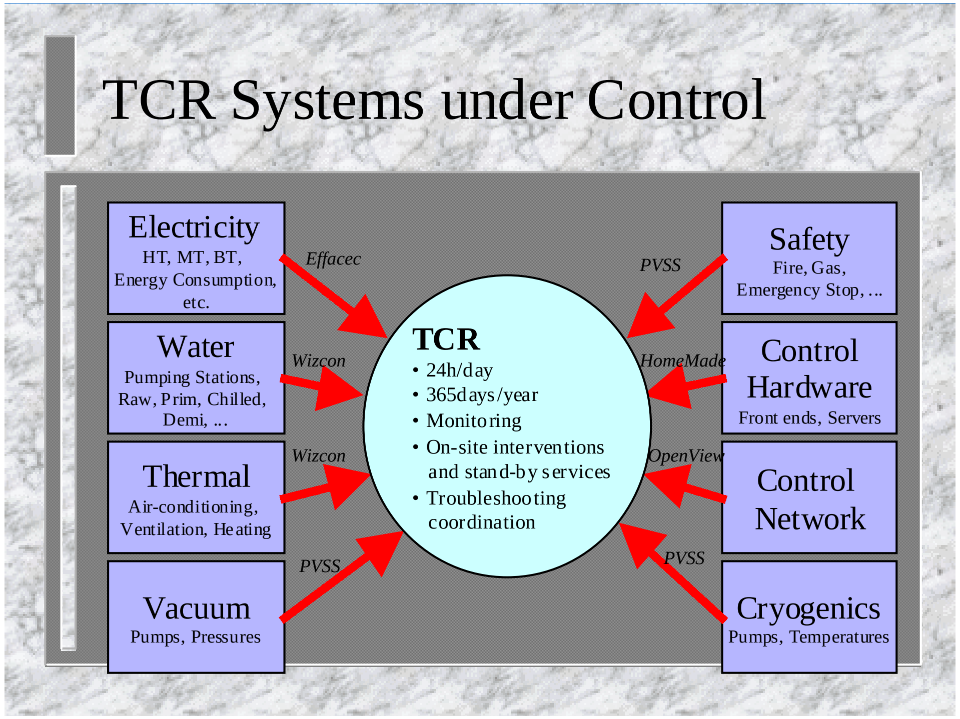

Electrical Network Supervisor (ENS) (courtesy S. Poulsen ST/EL)
Network backbone
Technical Control Room
X operator
Network Control Centre in Building 212 (Technical Control Room)
SCADA server
Backup
Watchdog
TDS Equipment
Electrical substation BA4
Local operator
Front End
Substation LAN (RS-485 loop)
Electrical control racks in BA4
RS-485 multi-drop
Data Acquisition Unit
Schneider SEPAMS for feeder and transformer
Various equipment signal
7


ST/CV Control System Architecture (Courtesy D. Blanc ST/CV)
Data archiving and web-based supervisory tools
Trouble Diagnosis
Post-mortem analysis
Layer 4: Data handling and web supervision
Web-access to layer 2
Archiving station
CERN technical data monitoring
Data coherence
Standardization of interfaces
Reference Data Base (for remote data configuration)
Technical Data Server
Layer 3: TCR remote supervision
Process control and supervision
Flexibility
Process-customized solutions
Windows NT Workstations
SCADA: Wizcon
Layer 2: Local supervision
Process regulation
Reliability
Availability
Maintainability
Cellbus: Ethernet TCP/IP
PLC: Schneider / Siemens
Layer 1: Acquisition and regulation


Access & Interlock courtesy T. Riesco (ST/AA)
SPS SAFETY SYSTEM ARCHITECTURE
CONTROL: S5-115U PLC / Sinec H1 / Sinec L2 / Hw lines
SUPERVISION: General: FactoryLink / HP-UX
Local: TCL/Tk / Linux
SPS=INB (2001) : An evolution of the SPS safety syste
required and is planned to be realised from now up to 2
New Installation
CNGS
PCR
CCR
Sites (BAs)
X-Terminal
SL/CO Ethernet
MIS
A&S
Master
Sinec H1
HP-UX Factory Link
A&S Central
MIS Central
Sinec L2
L2 lines
Hardwired Lines
A&S Local PLC
MIS Local PLC
Keys, Grids, Doors, Search Boxes,...
Magnets, RF Systems, Dumps,...
Local PC Linux
Central Data 8 ports
Intercom
EIS-A PLC
EIS-M PLC
EIS-Access
EIS-Machine
TCP/IP
Local PC Linux
EIS: Important Safety Elements (doors, RF.
EIS-A PLC: PLC for EIS Access
EIS-M PLC: PLC for EIS Machine


CERN Safety Alarm Monitoring
Safety alarm monitoring centre
Central Alarm Display at SCR
SCR console
TCR console
Laser printer 1
x2
SCR SCADA
PVSS
Safety alarm gateway to external systems (TDS, experiments, XCR, etc.)
Safety alarm networks
Hardwired
Service Network
Safety Network
CSAM supervision & maintenance manager
Local Alarm Synptic Panel Zone x
Local safety alarms controller
PLC 1
PLC 2
CERN safety equipment
13/7/2001
CSAM, L. Scibile
10


Control System Integration
SCR
Safety Control Room
TCR
PCR
WWW
Alarm/HCI/Log (PVSS based)
New Technical Data Server (PVSS based)
TCP/IP integration
I/O - PLC - Fieldbus
CERN Safety Alarm Monitoring (PVSS)
Electrical Network Supervisor (ENS)
Cooling & Ventilation Supervision (Wizcon)
Access Control & Interlock (Siemens & Factory Link)

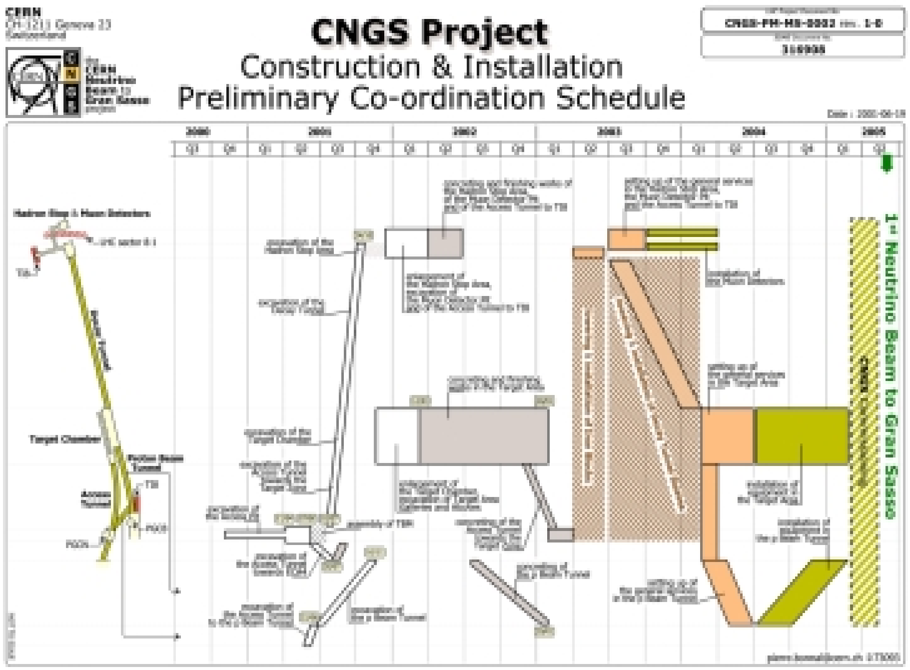

TCR Systems under Control
Electricity
HT, MT, BT, Energy Consumption, etc.
Effacec
Water
Pumping Stations, Raw, Prim, Chilled, Demi, ...
Wizcon
Thermal
Air-conditioning, Ventilation, Heating
Wizcon
Vacuum
Pumps, Pressures
PVSS
TCR
• 24h/day
• 365days/year
• Monitoring
• On-site interventions and stand-by services
• Troubleshooting coordination
Safety
Fire, Gas, Emergency Stop, ...
PVSS
Control Hardware
Front ends, Servers
HomeMade
Control Network
OpenView
Cryogenics
Pumps, Temperatures
PVSS

TCR Monitoring Requirements

- **What do you want ?**
- **Functional Analysis**
  - Which systems should work, when ?
  - What should they deliver ?
  - What are the interfaces & dependencies between the systems ?
- **Dysfunctional Analysis**
  - What to do when all goes wrong ?
  - Can the system become dangerous in case of functional or transmission path errors ?
  - Will the TCR know if some functions are not available ?

Conclusions

- **ST project co-ordinator: Mats Wilhelmsson (ST/CV)**
  - Control matters:
    - ST/AA: T. Riesco,
    - ST/EL: S. Poulsen
    - ST/MO: U. Epting, CSAM: L. Scibile
    - ST/CV: D. Blanc
- **Re-use of existing solutions (SPS … -> ...LHC)**
- **Industrial Control Systems**
  - variety: Factory Link, EFFACEC, PVSS, Wizcon
- **Data integrated in Control Rooms according to roles**
  - "who does what"
    - -> ~~SPS~~ restart after major breakdowns (TCR/PCR collaboration to be continued)
  - Big … B … amount of work in 2002-2003



TCR integration concept

- Overall monitoring mandate and specification
  - operators and equipment specialists
- Detailed specification of monitored points
  - operators, equipment specialists and IN staff
- Implementation in control system
  - ST/MO/IN + operators + C168
    - Limited resources -> only planned integration tasks!

COMMUNICATIONS SANS FIL

Voix

Surface GSM 900/1800, Walk.-Talk. UHF
Pompiers VHF simplex

Souterrain GSM 900
Pompiers VHF semi-duplex

Données

Surface GSM 900/1800 (fv 2400b/s, data 9600b/s)
GSM-HSCSD (9600/38400b/s)
GSM-GPRS (155Kb/s)
802.11 ISM 2.4GHz (11Mb/s)

Souterrain GSM 900
GSM-HSCSD
GSM-GPRS

Principe

Station de base GSM (14 canaux min.) et répéteurs VHF en surface (LHC 1, 2, 33, 4, 5, 6, 7, 8, BB4, P2)

Câble rayonnant et boosters en souterrain

Alarmes du réseau

Les stations de base GSM sont maintenues et contrôlées par SWISSCOM

Les alarmes des autres équipements seront traités par TCR

CONTRAT ACTUEL

OPÉRATEUR

- SWISSCOM MOBILE

ZONE CUG

- Ensemble du réseau SWISSCOM (Suisse + sites CERN)

ABONNEMENT FORFAITAIRE

- Gestion des abonnements
- Communications voix GSM/CERN – GSM/CERN
- Communications voix GSM/CERN – fixe CERN
- Communications voix fixe/CERN – GSM/CERN
- Stations de bases et répéteurs pour la couverture des sites CERN (LHC non compris)
- COMBOX et communications avec COMBOX
- Messages SMS GSM/CERN – GSM/CERN

COMMUNICATIONS VERS L'EXTÉRIEUR

- via le PABX CERN

CONDITIONS

- >2000 abonnements
- liaisons 2Mbits → bât. 58
- emplacements pour équipements SWISSCOM
- alimentation électrique

NÉGOCIATIONS PROCHAINES ou EN COURS

- Couverture LHC (y.c. TI2, TI8)
- Abonnement GPRS
- Communications GPRS data

INSTALLATION - PLANIFICATION

- Besoins

Stations de base supplémentaires (négociation avec SWISSCOM)

Choix et achat de ~45Km de câble rayonnant (MS)

Choix et achat des boosters (agréés SWISSCOM)

Installation (~35000 supports, tirage, connectique)

Liaison continue avec têtes de puits

Liaisons des stations de base par f.o. (2Mbit/s)

Alimentation secteur

Contrôle (selon type booster)

- Planification de mise en service

a) Avec les services généraux

b) Avant les géomètres (à l'étude)

CHOIX de la TECHNOLOGIE

- Collaboration CERN-IT-CS et Audit extérieur (TELEPLAN)

- Systèmes analysés

GSM
Standard
HSCSD
GPRS
EDGE

UMTS

WLAN
IEEE 802.11
HIPERLAN

DECT

MOBILE RADIO
PMR
PAMR

WIRELESS LOCAL LOOP

BLUETOOTH

IP Telephony over WLAN

- Besoins essentiels en surface et souterrain

Pompiers
Voix
Données

Interlocks

- **Hardware interlocks :**
  - **- The last gardian before “destruction”.**
  - **- Protection against operational errors.**
  - **- ~ fast interlocks should be hardware intlks (i.e. they hit the dump “directly”).**
  - **- Hardware ≠ no software involved !**
- **(Central) software interlocks :**
  - **- Protection level on top of HW intlks.**
  - **- Useful to prevent/anticipate dumps.**
  - **- Provides diagnostics..**
  - **- More flexibility & less safety (not fail-safe).**

Multi-cycling & interlocks

The present SPS interlock systems are not adapted to multi-cycling

A limitation for efficient running in the future !

TL hardware interlocks

To protect the CNGS/TI lines we will need ad-hoc extraction interlocks to protect the lines in case of hardware faults (PCs, vacuum, magnets,…).

⇒ To operate efficiently this system must be aware of the cycle that is being played !

else interlocks on CNGS will inhibit LHC beams (and vice-versa…) …

TL hardware interlocks (2)

At some stage we will also have to listen to the LHC :

- LHC *injection* interlocks :

- **At the latest in 2006.**
- **Can probably do without for LHC sector test...**
- **Must be “by-passable” for TL tests (TED in !).**

- LHC *beam type* interlocks :

How do we make sure that we send what LHC requests (pilot, nominal batch…) ?

Interlock build around SPS BCT…

TL hardware interlocks (3)

In the far future…

- LHC *beam quality* interlocks :

- **Intensity window : fixed or F(inside LHC).**
- **Beam emittance**
- **…**

Implementation ?

We have to start thinking about it …
Requires a certain level of flexibility
-> at the edge of hardware & software intlks

Software interlocks : the future

The present SSIS system cannot handle multi-cycling and is not aware of what cycle is being played.

→ a more flexible & cycle-aware system is being developed in the framework of SPS2001

Hopefully implemented in 2003/4…

Hardware interlocks : the future

- **Must think about a cycle-aware HW intlk system.**
- **To ease maintenance … , it would be worthwhile to share design choice of the future LHC intlk system. But :**

- LHC timescales ~ 2005 (for beam intlk system)
-> too late for TI/CNGS commissioning
- LHC intlk system is short of manpower …

INBOPerationS, LTI and CNGS

- INB activities, in general, concern:
  - Zonage
  - Traceability
  - Waste management
  - Documentation
- LTI and CNGS are fully implicated within the INB, like SPS and LHC
- The operational scenario for the SPS will be defined in the coming months under a new project which has yet to be established
- Some controls requirements are already clear

Waste Management

- This is a driving factor in many of the operational activities
  - well documented (full radionuclide inventory), compacted, low level activity waste - has a minimum cost ~30 kCHF/m^3 for disposal
- Classification of materials coming from within the 'Installation' is based on the zonage
  - which is established on the basis of the original design, calculations and operational history/experience - NOT MEASUREMENT
- Once classified in a radioactive category, equipment cannot be de-classified
  - the number of anomalies in the zonage should be minimised (zero)

Logging and Monitoring

The following data are required to establish a full history and as input data for simulations

- Beam currents and energy
- Beam losses and their distribution
- Optics configuration (including steering)
- Radiation monitoring

Other Components with INB Constraints

Some of these may have implications for the control system

- Quality control
- Control and interlocks of equipment with significant safety implications (Eléments Important pour le Sécurité)
- Access control

The following are important but unlikely to have controls implications

- Traceability system
- Radiation surveys and measurements (sampling and checks on equipment removed from the perimeter)
- Individual dosimetry

Conclusions

- INB Operations impact mainly on monitoring and logging within the control system
- Access control and EIS will feature in INB documentation and the regular inspections.
- INB quality assurance will have an impact on all of the systems mentioned
- A permanent record covering the life cycle of LTI and CNGS components is essential for proper waste management