

DESY/ XFEL

Cryogenic and Utility Controls

EPICS Meeting – Status Reports

DESY, April 24, 2006

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Overview

- EPICS at DESY
- Cryogenic Controls
- Utility Controls

EPICS at DESY

EPICS at DESY is representing the 'IC' in EPICS

→ Industrial Controls

EPICS is used for:

- All Cryogenic Systems are (or are going to be) controlled by EPICS
EPICS as a DCS (Distributed Control System)
- Several Diagnostic Implementations (Power Monitoring, Weather-Station...)
- Utility Controls (Water, Power, Air Conditioning...)
EPICS as a SCADA System

EPICS at DESY

EPICS is NOT used for:

- Machine Controls
- Beamline Controls
- Slow Controls in the HERA Experiments
(Except the Cryogenic Controls for the ZEUS Magnet)

Special Requirements for Cryogenic Controls

- **General:**
 - 24/7 operation for more than one year
 - Reliability!
 - All PCM's(D/3)/ IOC's are running on UPS
 - All (Sun) server and ~40% Display stations running on UPS
- **HERA:**
 - Redundancy (actually only available for the D/3)
 - PCM (front end controller)
 - Power Supply
 - Control Network
- **FLASH/ CMTB:**
 - Permanent operation for more than two years (FLASH linac)

EPICS IOC running since 2004

- EPICS IOC's are very reliable
- I/O controller (IOC) controlling helium flow and pressures in the FLASH cryo modules
- Running on UPS
- Single VME board
- But: No maintenance is possible without a redundant pair of IOC's

ttfKryoLinac Parameter epicsVME04 ● Heart Beat

Contact Person: Schoeneburg/2464

CPU Application: TTF Linac Kryo Controls

Home Path: /vxBoot/ioc/ttf/ttfKryoLinac

Running since: Mar 18, 2004 22:08:59

Board Type: Motorola MVME162 / 16MB

Epics Release: R3.13.8-D4

vxWorks Release: 5.3.1 / BSP 1.1/4

Last Change Val.:

Last Change Time:

Last Saved: NO SAVE Last 8 caPut's

IOC Info: Test

Process Info: ● save Request

Archive current settings: setSaveBit Max Memory Block Free: 8435448 Bytes

Start Burtgoeey: !

Save/Restore Parameters: ! !

Other Displays: Monitor System Reboot: Reboot VME Time on IOC: Nov 24, 2006 08:27:44

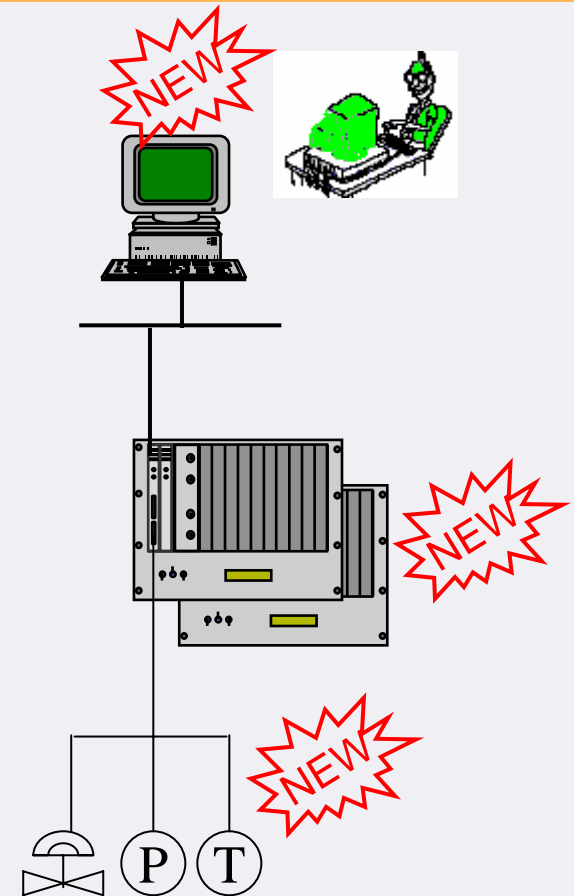
Cryogenic Control for the XFEL

Cryogenic Components to be controlled

- CMTB (in operation)
- HERA Plant (for FLASH) (planned for 2007/8)
- HERA Plant (for XFEL)
 - New Cryogenic Plant for the XFEL (alternative)
- AMTF
- XFEL Tunnel

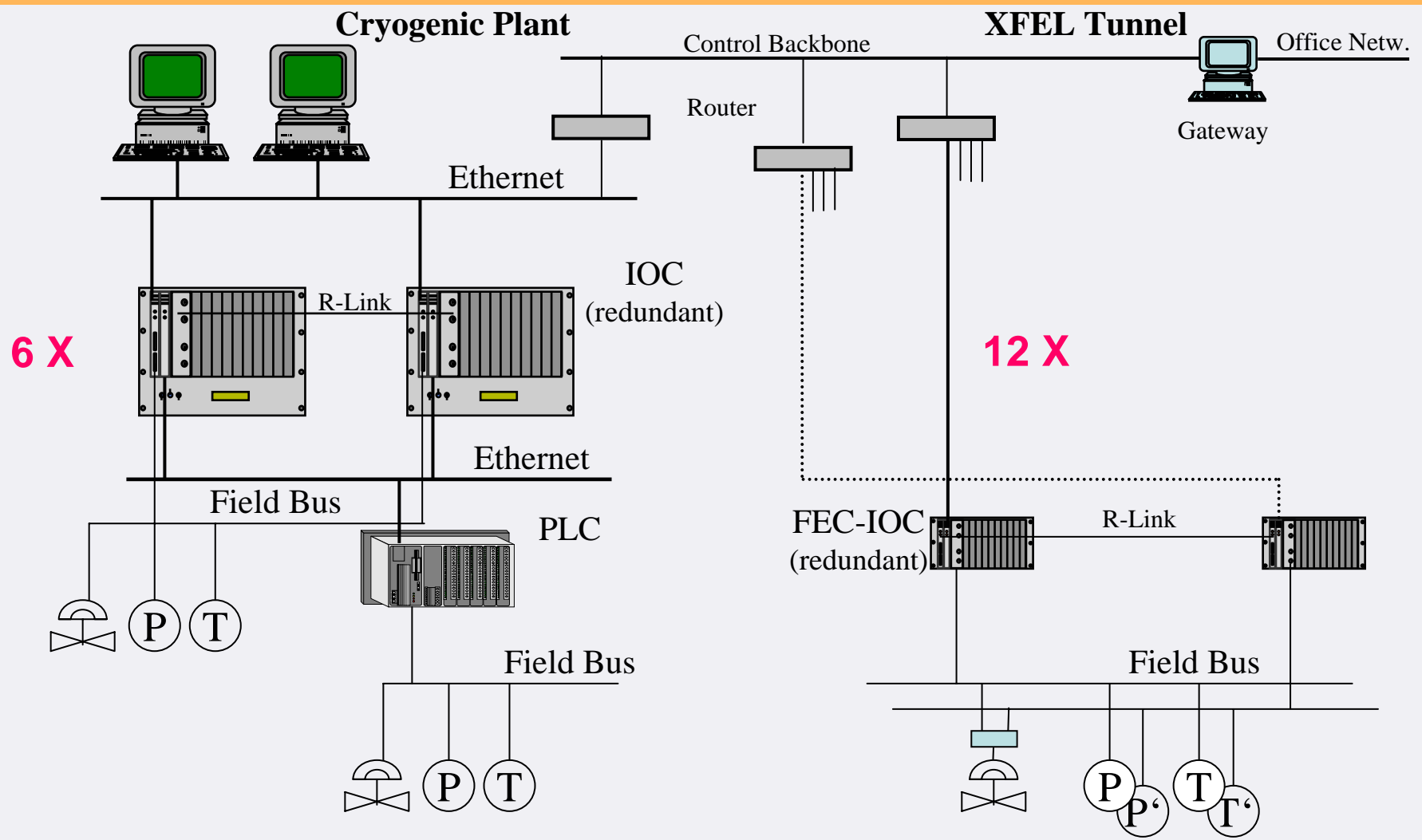
Technology Choices for the XFEL

- Display running on 'any' operating system supported by (1)Java, (2)Eclipse
- New Alarm System based on Java Message Services
- Configuration of runtime databases, graphics, trends and alarms (EPICS-Ora)
- Ethernet communication
- Front-end controllers (IOC)
 - uTCA? (Compact-PCI), DIN-Rail-PC, μ Dimm
 - Running real-time VxWorks, (RTEMS)
 - Redundant IOC's
- Soft IOC (I/O Controller)
 - Windows and Linux PC's
- I/O connected through field-buses
 - Profibus (DP)
 - High precision low temperature measurement
- Condition Monitoring (FDT)
 - Querying intelligent sensors on Profibus DP/PA
- I/O connected through Ethernet
 - Siemens-IP, ProfiNet, BACNet (MKK)



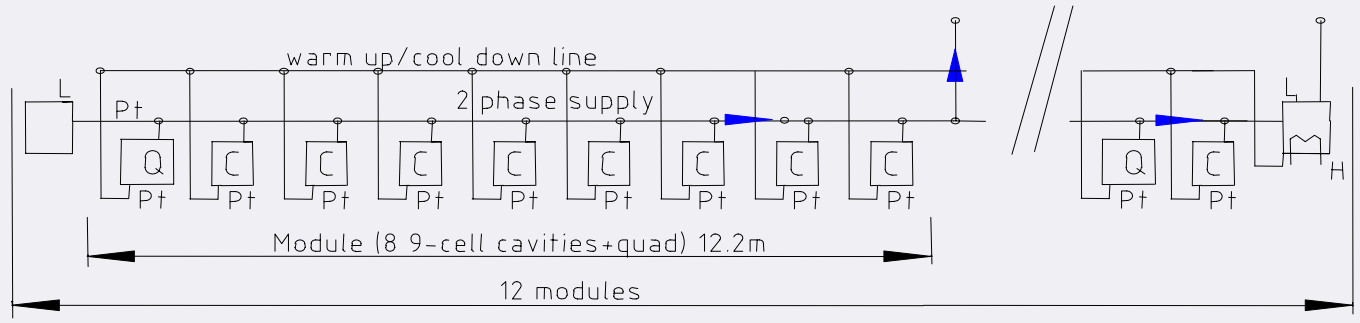
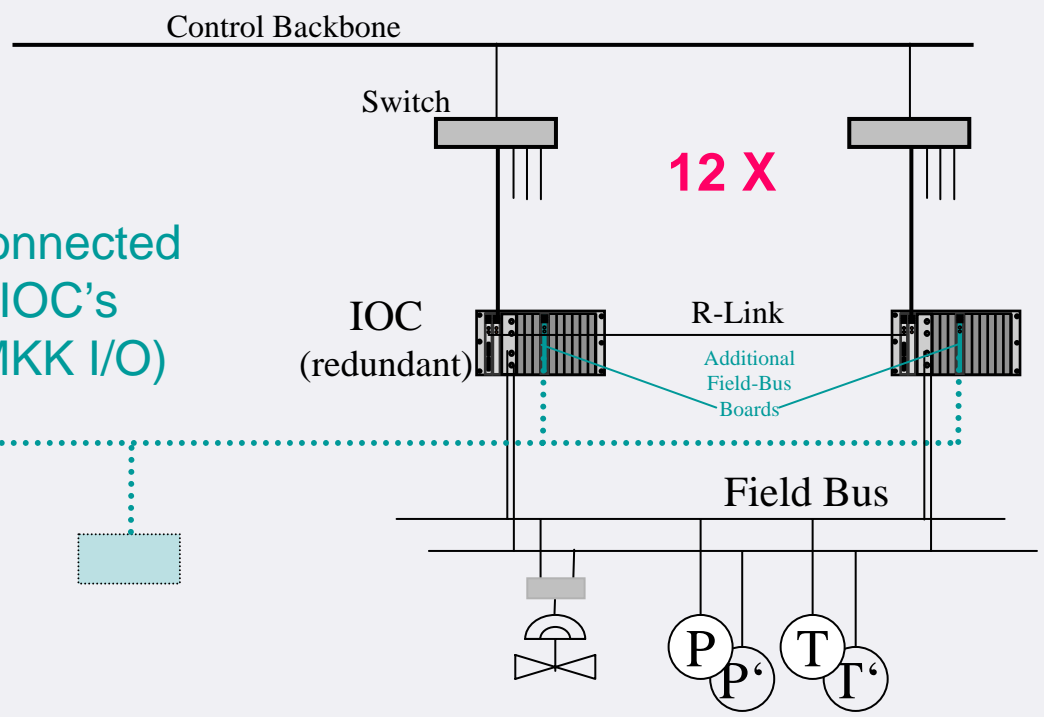
New Developments: Redundant Front-Ends

Principle Layout of the XFEL Cryogenic Control System

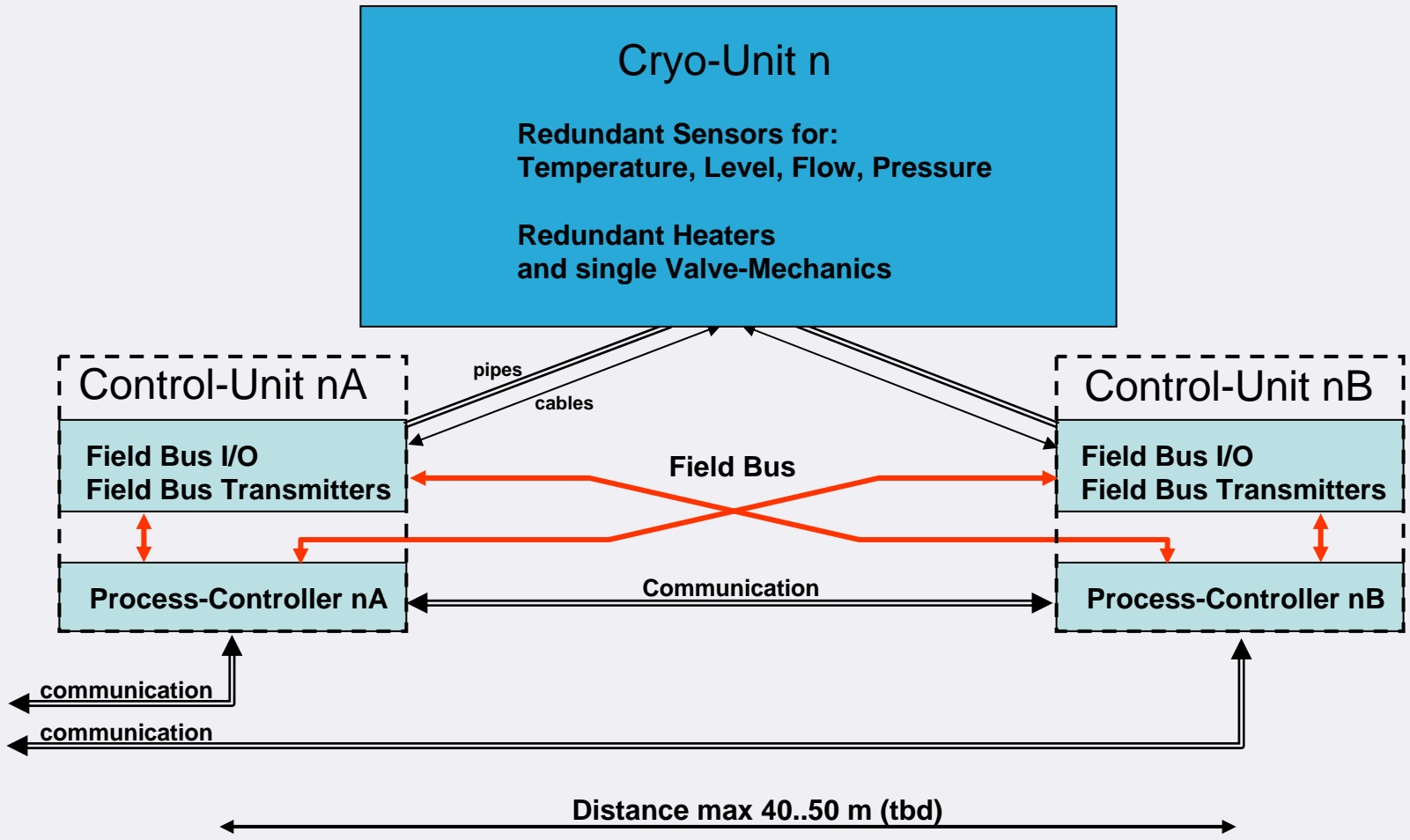


Redundant Front-Ends: High Availability Cryo Controllers (also) for other Applications

Distributed I/O can be connected (redundantly) to cryo IOC's (Option for distributed MKK I/O)



Redundancy concept for Cryo Controls in the XFEL tunnel to tolerate “single events” caused by radiation and allow service of HW and SW without interruption of the process



Tasks of MKK at DESY

power distribution

- 110KV, 10KV, 400V three-phase current
- emergency power supply
 - UPS, batteries, emergency generator
- DC



tubes



Tasks of MKK at DESY

water-cooling

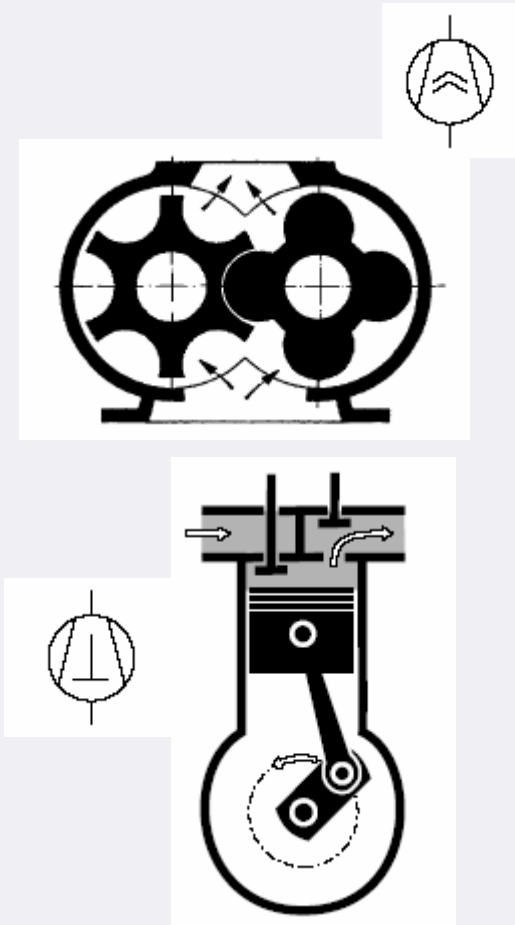
- for accelerator, cryo plants, air conditioning
 - produce by cooling tower
- cooling water $>16^{\circ}$ degree
 - produce by cooling tower
- cold water $< 10^{\circ}$ degree
 - div refrigerating machines



Tasks of MKK at DESY

compressed air

- generation and distribution
- user
 - high voltage switches
 - valves
 - etc



Tasks of MKK at DESY

air conditioning and heating

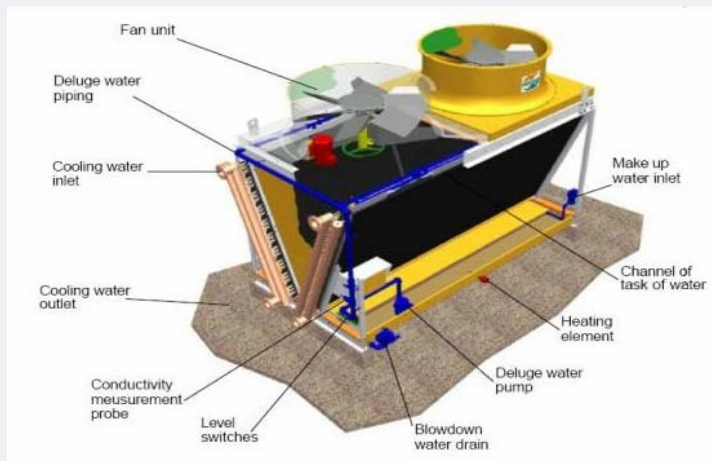
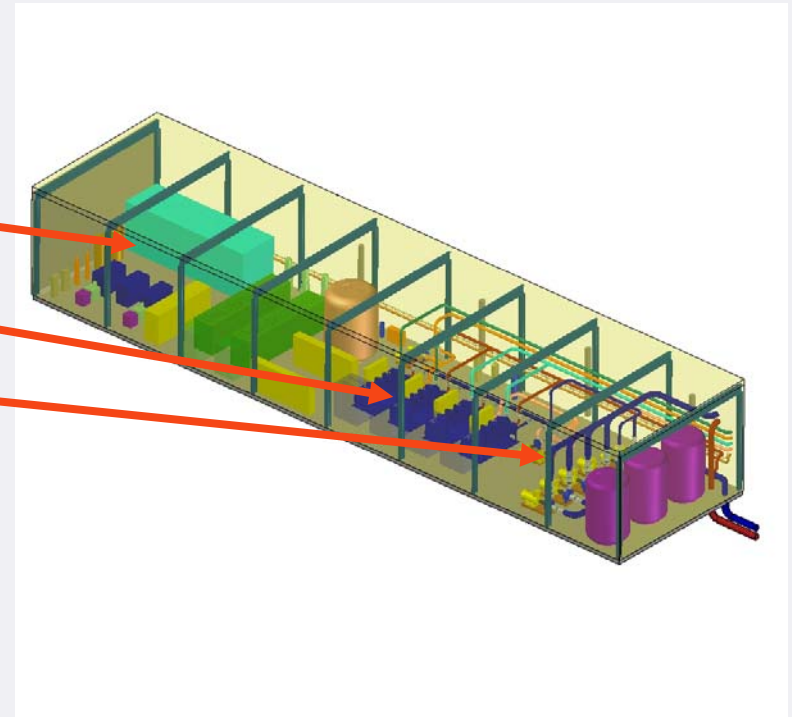
- heating
 - DESY buildings with a remote heating system
 - some halls with gas
- air conditioning
 - accelerator
 - computer centre
 - etc



Water cooling at XFEL

Water cooling plants

- Pump station
 - Water treatment
 - Chiller
 - Pumps, valves, pipes
- Hybrid ~~cooling tower~~



Water cooling at XFEL

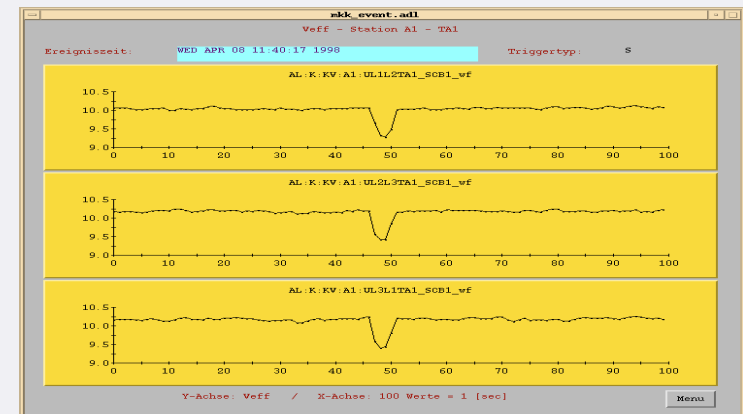
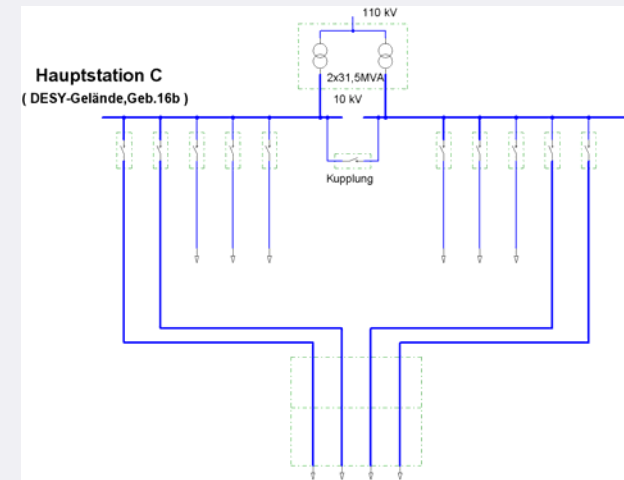
Consumer in tunnel XTL

- Klystron, Absorber
 - Temperature of water
 - Water pressure
 - Water flow
 - Position of valves
- Data acquisition of 1700 data points
 - Plant protection
 - Visualization

Electrical Power Distribution

Control system requirements

- Visualisation of switchgear
 - Display status of switches
 - Display of power flow
 - Efficiency of mains
- Control power quality
 - Transient-recorder detects voltage drop



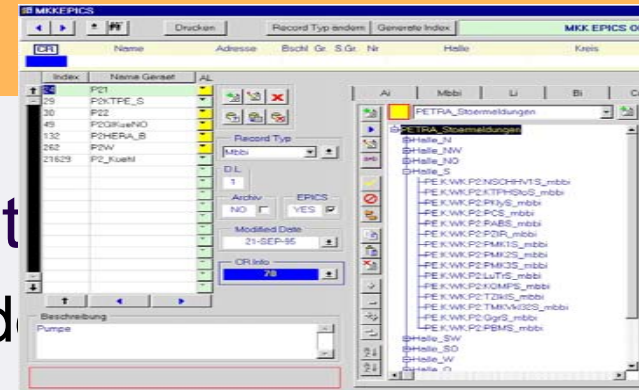
Control level

Automation und Control

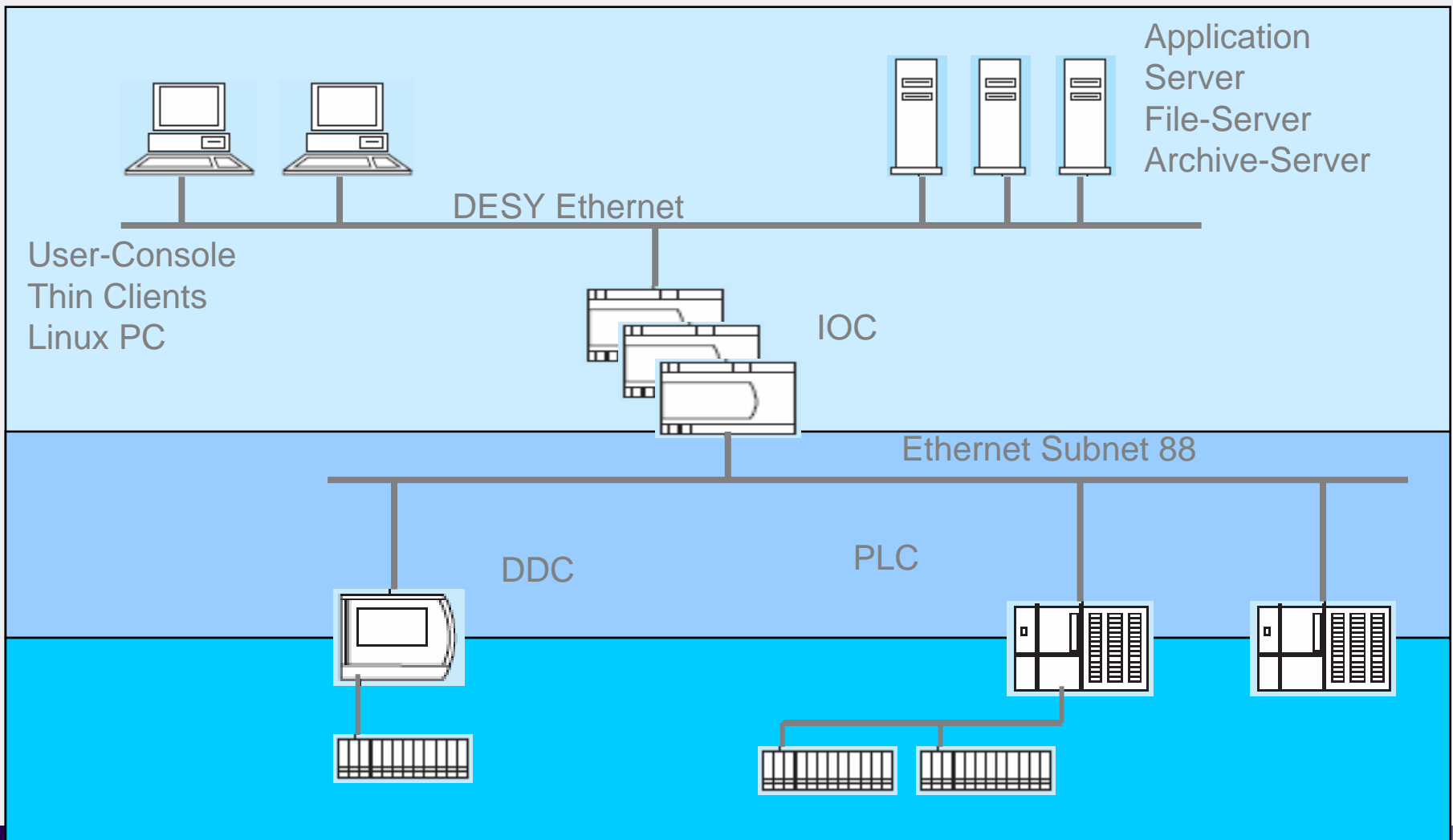
- Functions of control systems are used by MKK staff
 - Plant visualisation
 - Tools for operating and watching plants. Show plant status with graphical elements
 - Alarming
 - Alarm management tool. Alarms are shown structured by group of plants or group of users. Different alarm levels are necessary
 - Call troubleshooting service by SMS
 - Creating log files to reconstruct plant troubles
 - Archiving, Trending
 - Long term archiving of measurement and plant status
 - Optimize behavior of plants and control loops
 - Evaluate efficiency of plants
 - Check history of plant troubles

Oracle: Tool to manage EPICS

- administrates all MKK data point
 - data source, data typ, hardware address
- checked unique channel name
- input wizards for EPICS ioc database data
 - alarm limits, alarm severity, monitor dead band,
- Generate ioc database text file
- generate, administrates alarm handler config-files
 - different alarm handler for different user groups



System overview



Cooperation with DESY Utility Group (MKK)

Starting from the early HERA days (in 1993)
the groups MKK and MKS are working together.

- MKK is using EPICS as a SCADA System
(SCADA: Supervisory Control And Data Acquisition)
(No process control (control loops) on the IOC's)
 - MKS is providing/ developing EPICS applications:
 - Synoptic Display, Alarm-Handler, Archiver, Archive Displays
 - IOC-core/ drivers
- MKK is configuring:
 - IOC databases
 - Graphics
 - Alarm-Handler
 - Channels to be archived

MKK and MKS have decided to continue
their cooperation for the XFEL using EPICS