The European X-Ray Laser Project XFEL

XFEL
Cryogenic Controls

DESY-Zeuthen Seminar für Ingenieure

DESY, May 23, 2006

Matthias Clausen
MKS-2 Kältekontrollen

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Agenda

- A brief Introduction to Cryogenic Processes
- The HERA Cryogenic Plant
- Process Control Requirements
- Special Cryogenic Measurements and Controls
- A brief Introduction to EPICS
- EPICS for Cryogenic Controls
- EPICS for Utility Controls
- Actual Plans for the XFEL Cryogenic Control System
- Outlook
- Summary

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Thermodynamic cycles

To create low temperatures a working agent, cryogen, is processed in order to absorb heat at low temperature and reject it above ambient temperature

This process is called a thermodynamic cycle

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The T-s Diagram

The T-s diagram is and ideal tool to represent thermodynamic cycles

Log T - s diagram of an ideal gas shows straight lines for:

- Isenthalps (= Isotherms)
- Isochors
- Isobars

If in a Log T-s diagram the above mentioned lines are straight

- The gas shows ideal behavior in this area

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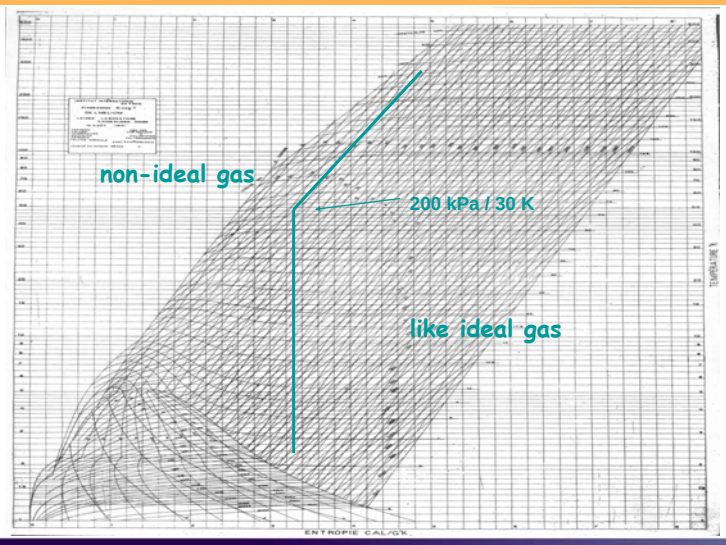
Log T-s Diagram for Helium



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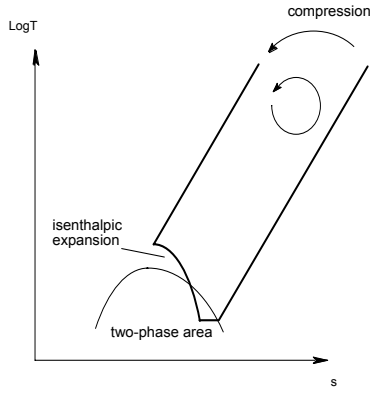
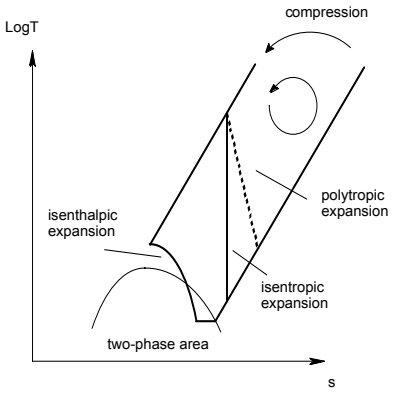
Basic Cycles



Joule-Thomson cycle



Claude cycle

(= Joule-Thomson & Brayton)

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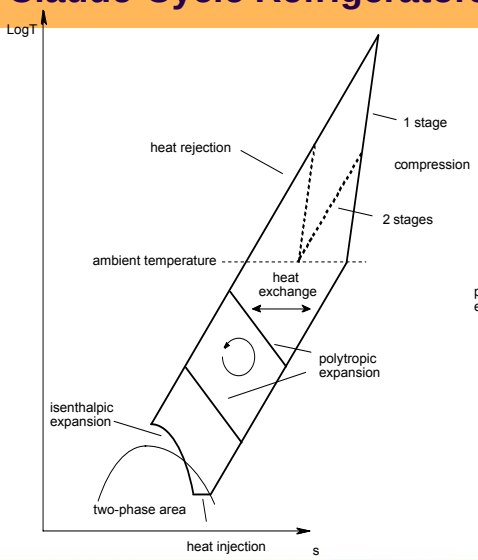
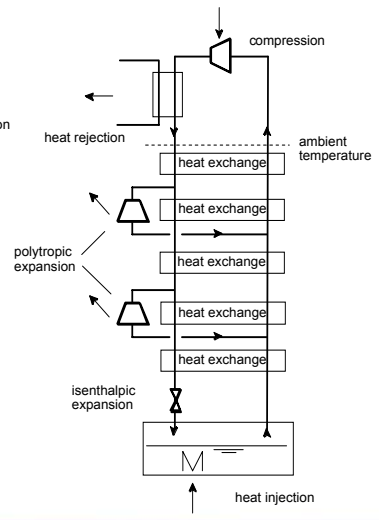
Claude-Cycle Refrigerators





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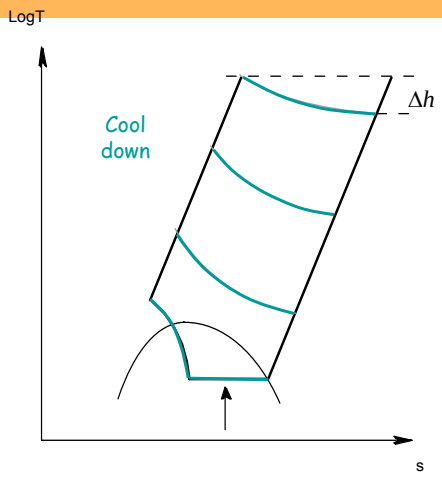
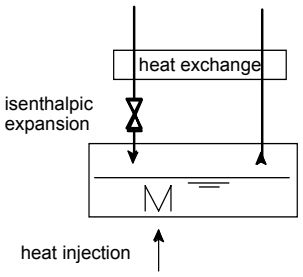
Joule-Thomson stage





Energy balance:

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Joule-Thomson stage

Joule-Thomson inversion temperature

Fluid	Maximum Joule-Thompson inversion temperature [K]
Helium	43
Hydrogen	202
Neon	260
Air	603
Nitrogen	623
Oxygen	761

Helium: effect useful at T<15 K

Compressors

Oil lubricated screw compressors

- Oil lubricated
- Advantage: volume flow / Oil cools the helium (T_{out}~ 80 deg. C)
- Disadvantage: Oil in helium

Oil has to be taken out before entering the cold part

In the compressor: 2-5% mass helium in oil
After oil removal: < 10 ppb mass oil in helium

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Compressors

Oil lubricated screw compressors

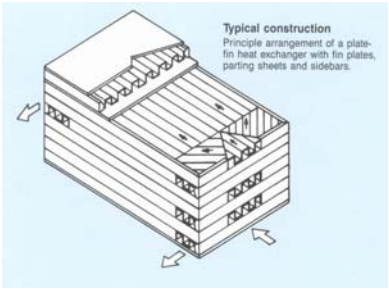
- Compression process

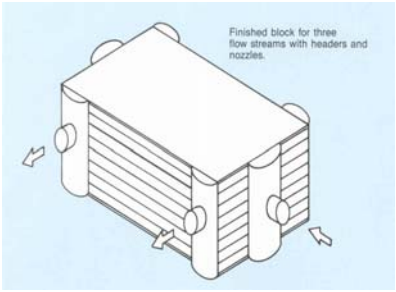
Volumetric compressor

Courtesy of AERZENER Maschinenfabrik

Aluminum-plate-fin HX

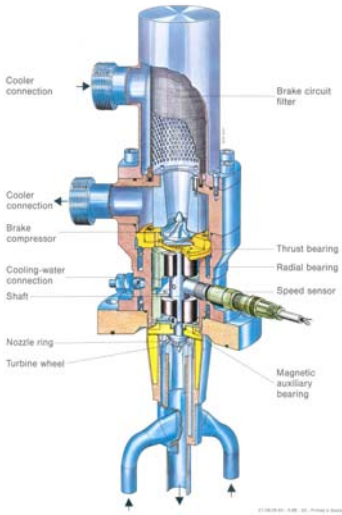
Specific HX surface: ~ 1000 m^2 /m^3





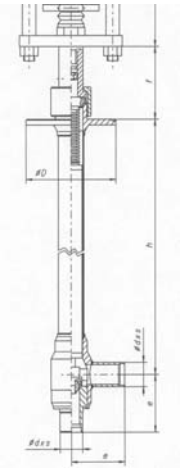
Courtesy of LINDE AG

Turbo Expanders



Courtesy of Linde Kryotechnik AG

Cryogenic valves



Long stem to
decrease heat leak

Courtesy of WEKA AG

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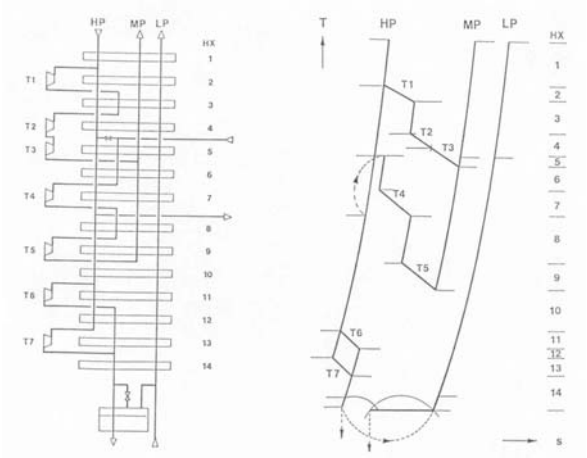
Example HERA refrigerator



Published in Adv. Cryo. Eng. 31, 693 (1986)

Example HERA refrigerator

Total exergetic efficiency:

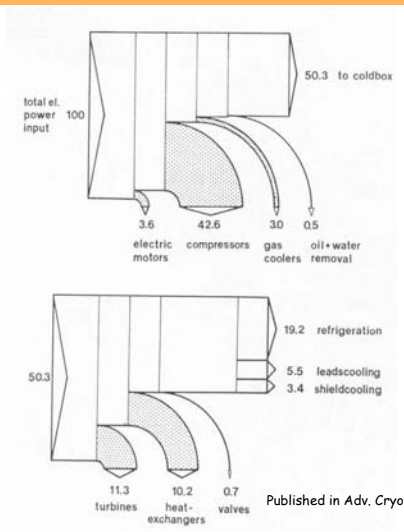
28.1 %

or

28.1% of Carnot

i.e.

250 W / W @ 4.3 K



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HERA Cryogenic Plant

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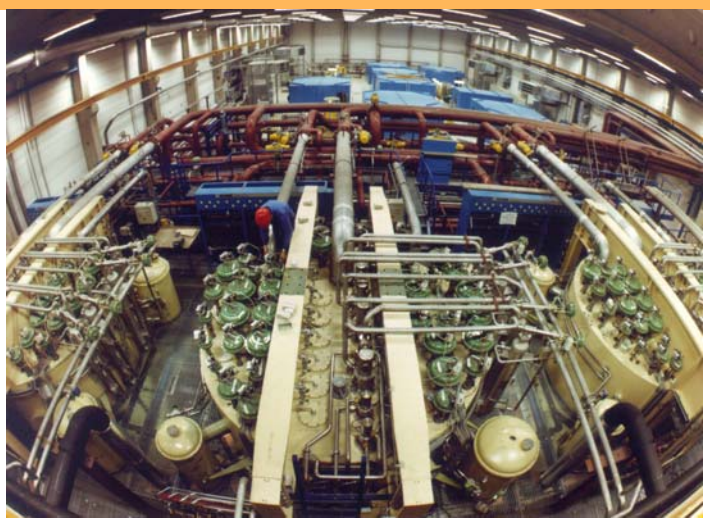
HERA Cryogenic Plant



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Screw Compressors

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Compressor Huts

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Pressure Transducers

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HERA Magnets

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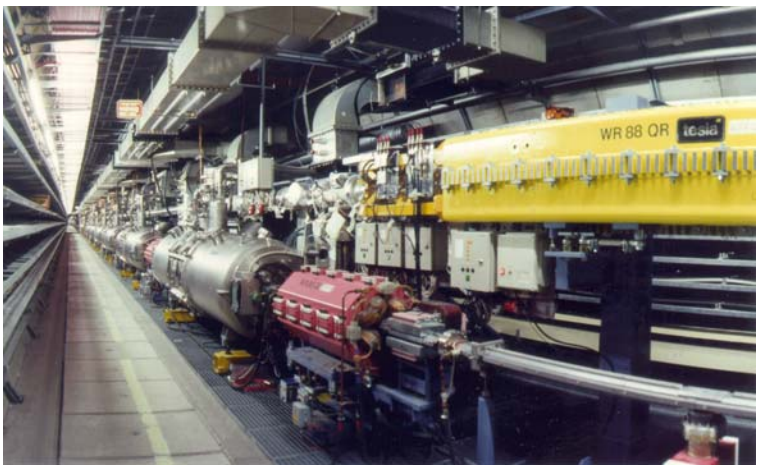
Super conducting Cavities for the Electron Ring



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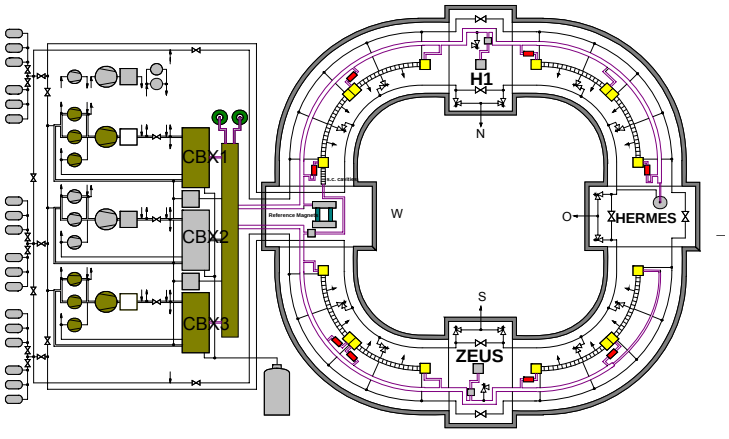
Cryogenic Hall HERA Accelerator Ring



Refrigeration at 4.3 K	6.775 W		Total helium massflow rate	871 g/s
Refrigeration at 40 / 80 K	20.000 W		Max. energy consumption	2.845 kW
Current leads cooling (Liquifaction)	20.5 g/s		Spec. energy consumption	281 W (300K) / W (4K)

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Process Control Requirements

- **Continuous Processes:**
  - Analog Control
    - ⇒ **Closed Loop Control**
  - Digital Control
    - ⇒ **Digital Logic**
- **Sequencial Processes:**
  - Sequencer

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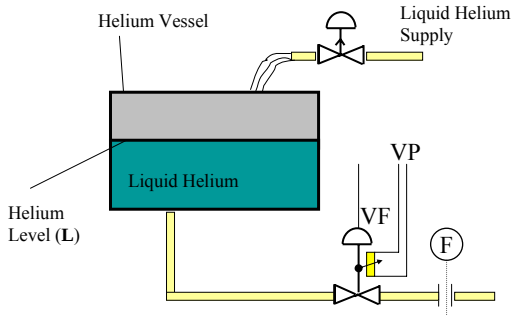
Control Loop Example



Exercise:
Control the flow (F) with the valve VF independant of Helium level (L)

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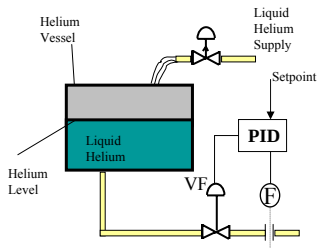
Cryogenic Control Loop Example



Available input data:
-Flow (F)
Available control device:
-Valve (VF)
Control Algorithm:
-PID
-Control Value (F)
-Output Value (VF) (0-100%)

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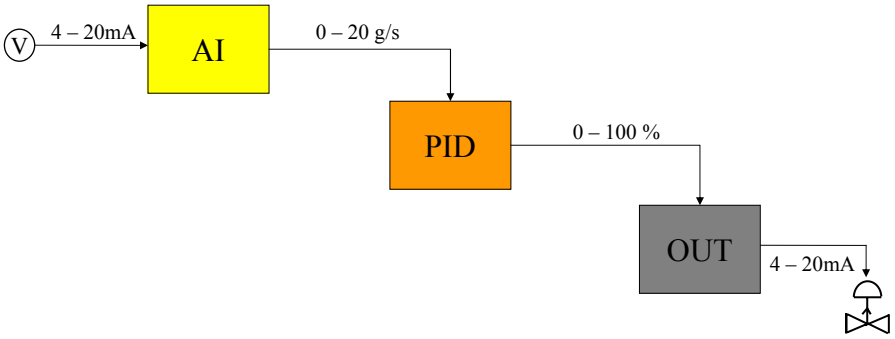
Cryogenic Control Loop implemented in EPICS



VDCT Screendump

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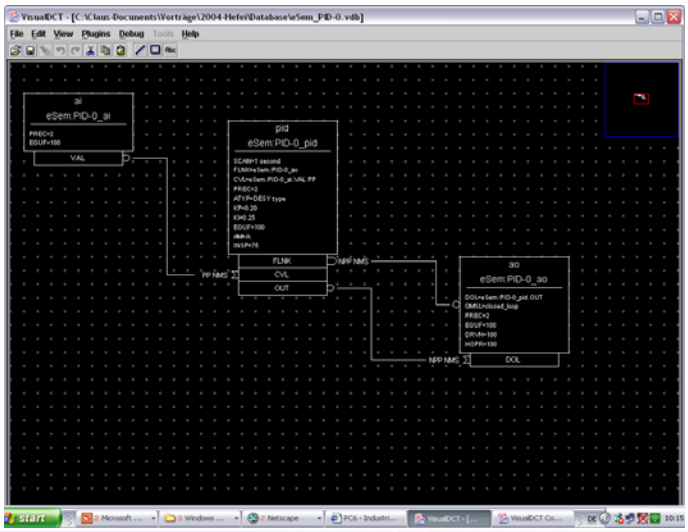
Control Loop – Block Structure - implemented in VDCT



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The corresponding Database

```
record(ai, eSem:PID-0_ai) {
  field(PREC, "2")
  field(EGUF, "100")
}
```

```
record(pid, eSem:PID-0_pid) {
  field(SCAN, "1 second")
  field(FLNK, "eSem:PID-0_ao")
  field(CVL, "eSem:PID-0_ai.VAL PP")
  field(PREC, "2")
  field(ATYP, "DESY type")
  field(KP, "0.20")
  field(KI, "0.25")
  field(EGUF, "100")
  field(AM, "A")
  field(INSP, "75")
}
```

```
record(ao, eSem:PID-0_ao) {
  field(DOL, "eSem:PID-0_pid.OUT")
  field(OMSL, "closed_loop")
  field(PREC, "2")
  field(EGUF, "100")
  field(DRVH, "100")
  field(HOPR, "100")
}
```


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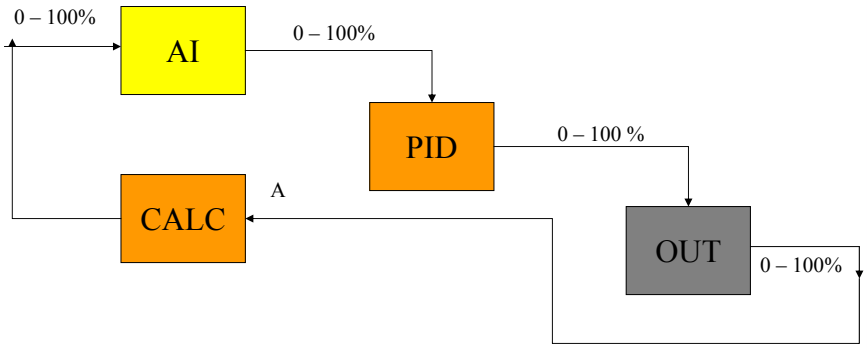
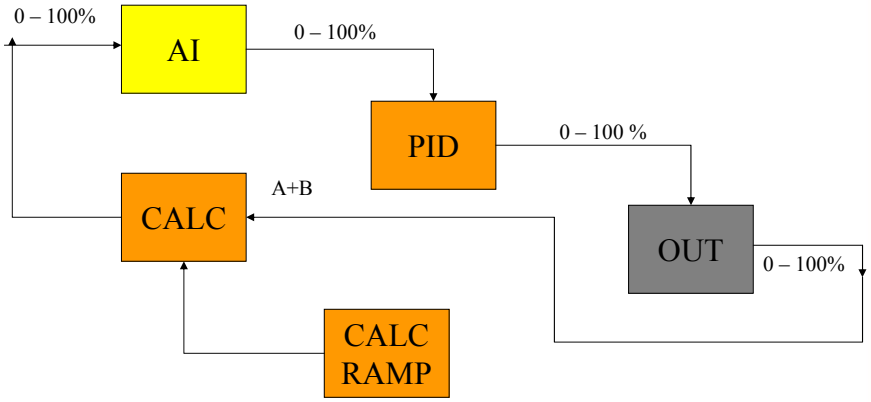
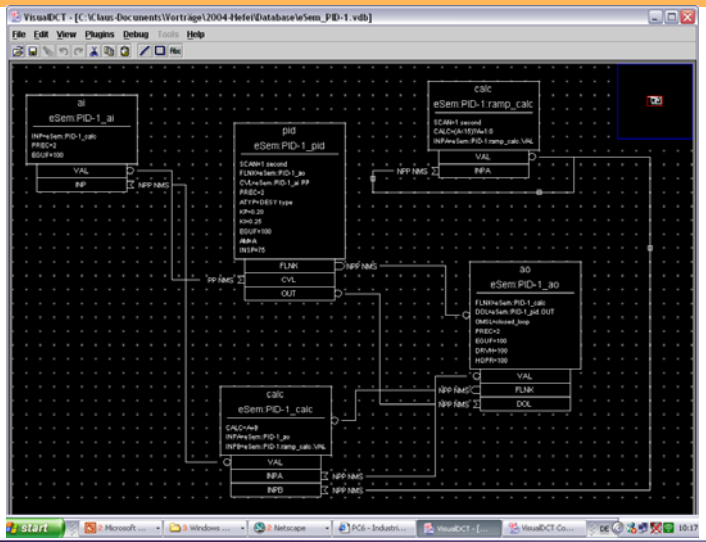
Closing the loop
Using a calculation ecord



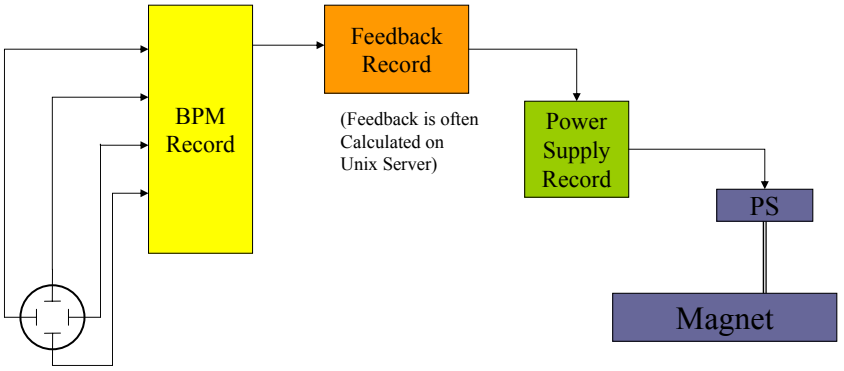
Simulating a distortion



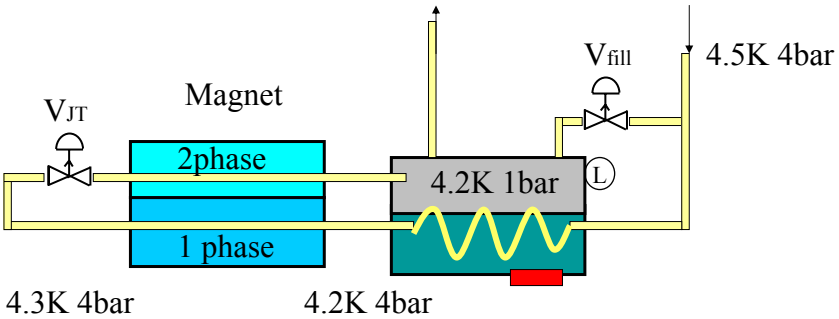
Control Loop – closing the loop and distortion - implemented in VDCT



Special Records often make live easier



Control Loop Example



Level (L) can be controlled by:
Heater
JT Valve
Fill Valve

Sequence Programs

Supervisory Programs

- **Checking the state of several componentes …**
  (Valves, pressures, temperatures, flows …)
  … and performing programmed actions.
  (activating valves, shutting down equipment …)

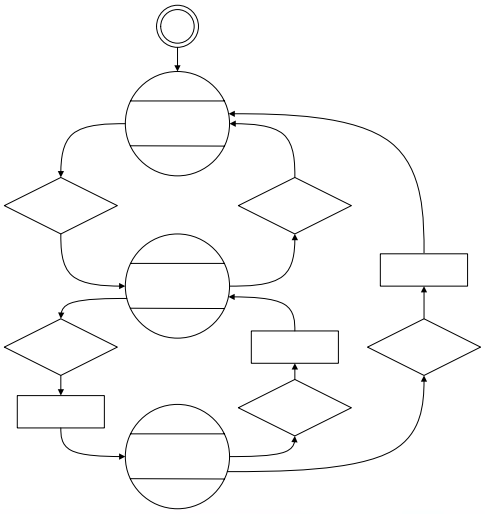
Procedural Programs

- **Cooldown procedure**
- **Warmup procedure**
- **Quench recovery procedure**
- **…**

States of a Supervisory Program (example)

	A12		**A14**	**A15**	**A21**
Alarm-Bedingung	TS1 **und** TS2 zu kalt oder zu warm		P9 zu hoch	P9 sehr hoch	PS21.SEVR MAJOR
Aufhebungs-Bedingung	TS1 **oder** TS2 ok (incl. Hysterese)		P9+Hyst. ok	P9+Hysterese ok	PS21-Sevr NO_ALARM
Aktion 1 Entry (disabled)	n.v.		n.v.	Blockierung A14 aufheben	n.v.
Aktion 2 Übergang zu ALARM	Hss-Regler blockieren		V57 öffnen	A14 blockieren V57 schließen	V9 schließen …V17 öffnen
	HSS aus wenn heiß	HSS ein wenn kalt			
Aktion 3 Übergang zu NO_ALARM	Hss-Regler freigeben (Event-Flag)		V57 schließen	Blockierung A14 aufheben	n.v.
Aktion 4 Übergang zu DISABLED	Hss-Regler freigeben		n.v.	n.v.	n.v.

… corresponding State Notation



State Notation Programs

SNL Programs are mainly running on the Frontend Processor.

They can also be started on any workstation connected to the controls network.

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Special Cryogenic Measurements and Controls

- **Current Leads Control**
- **Helium Level Control**
- **Heater Control**
- **Low Temperature measurements**

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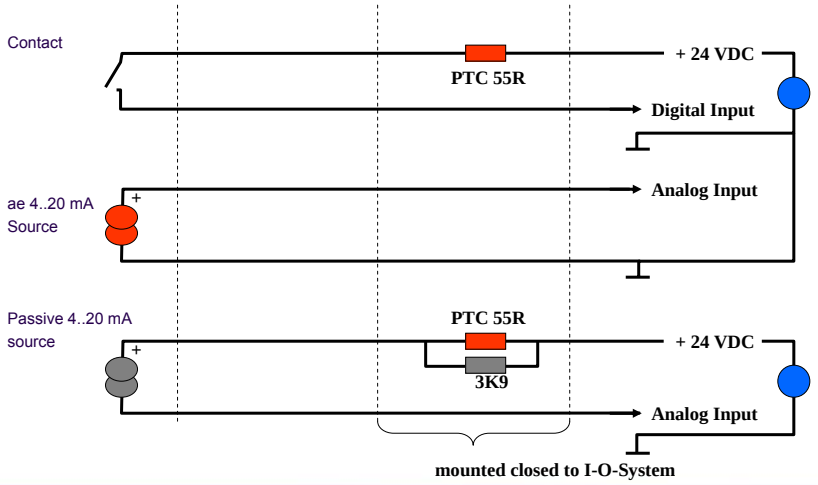
How to connect Sensors and Actuators to an I-O System

Sensor: **Cable:** **Protection:** **I-O-System:**



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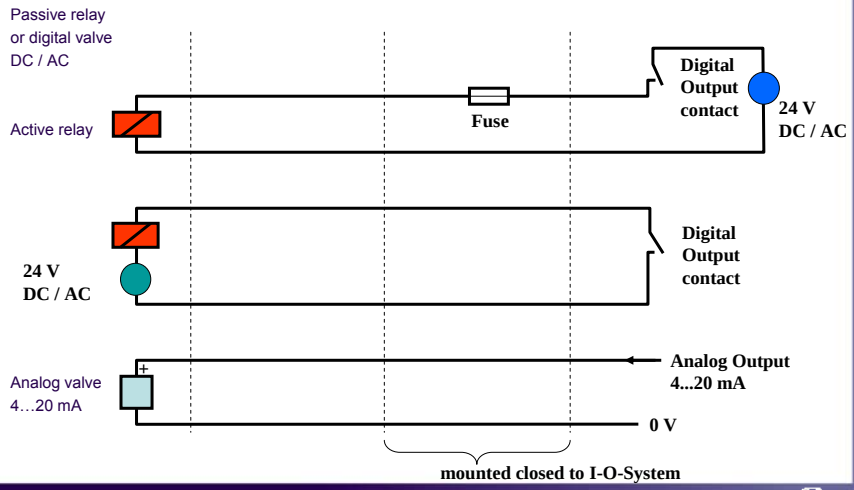
How to connect Sensors and Actuators to an I-O System

Actuator: **Cable:** **Protection:** **I-O-System:**



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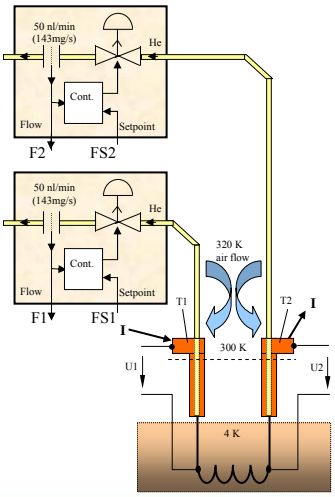
Principle diagram for the cooling of a pair of current leads (magnet coil current 550 A)



(Max of U1, U2) = U Max of lead voltage

FS1 = FS2 = $\dot{m}$ Setpoint for He mass flow

$\dot{m}$ = d if U < 5 mV

$\dot{m}$ = a * U^2 + b + c * ΔU / Δt if U ≥ 5 mV

$\dot{m}$	[mg s^{-1}]
U	[mV]
ΔU / Δt	[mV s^{-1}]
a	[µg s^{-1} mV^{-2}]
b	[mg s^{-1}]
c	[mg s^{-1} mV^{-1} s]
d	[mg s^{-1}]

Typical values for parameters a, b, c and d

a = 30 [µg s^{-1} mV^{-2}]
b = 15 [mg s^{-1}]
c = 200 [mg s^{-1} mV^{-1} s]
d = 5 [mg s^{-1}]

Typical values in steady state (I = 550 A)

$\dot{m}$ = 40 mg s^{-1}
U1, U2 = 27 mV
T1, T2 = 280 K

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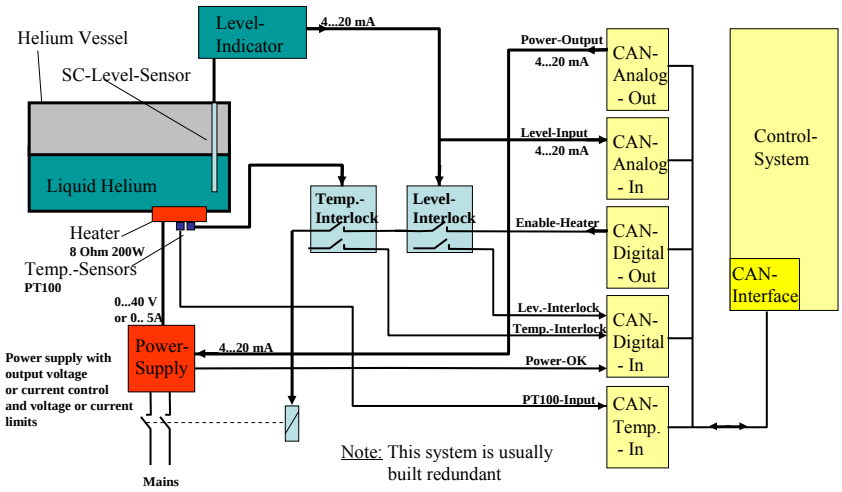
Principle diagram for the control of a heater in liquid helium (heating power 200 W)



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Heater Control and - Protection

Heaters are soldered in a cryogenic vessel which is installed in a vacuum insulated cryogenic tank.

Special precautions must be taken to protect the heater against burnout:

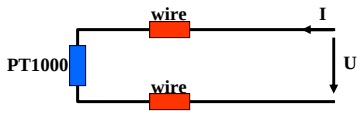
- **Check that there's helium in the tank**
- **Check that the temperature is low enough**
- **Both conditions must be true to enable heater operations**

In addition to the protection – additional precautions are implemented:

- **Redundant control loops**
- **Redundant heaters**

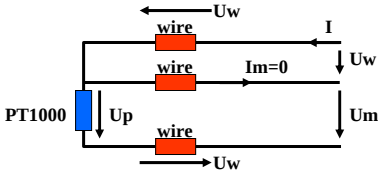
PT1000 Measurement Principles

2-Wire-Technique



If you supply the current I and measure the voltage U you can calculate the resistance of the PT1000 incl. 2 x the wire resistance.
If you have temperature changes influencing the wire you will have additional errors.
Have in mind that the PT1000 has about 3.9Ohm/ºC. For low wire resistance (< 1 Ohm) and +- 10 oC temperature changes of the wire you get errors in the range of 0.6 ºC.
Note: if you use PT100 the errors are 10 times greater.

3-Wire-Technique



If you supply the current I and measure the voltage Uw and Um you can calculate the voltage Up by Up = Um-Uw. In this case you will have no influence of the wire resistance or change of this
If you take care that all 3 wires are identical (in one cable for equal temperature influence).

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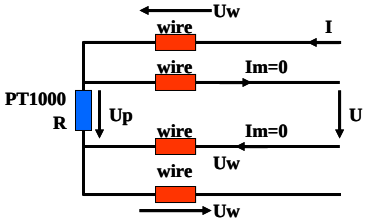
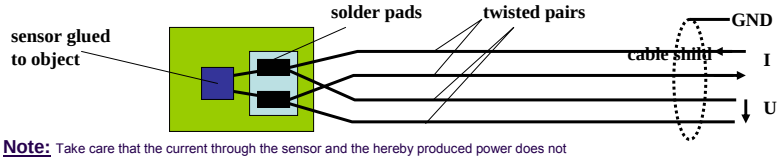
PT1000 Measurement Principles

4-Wire-Technique



If you supply the current I and measure the voltage U you can calculate the resistance of the PT1000 by R = U/I. Because of the current less voltage measurement (Im=0) you measure the voltage which is present at the PT1000. In this type of measurement the wire resistances and their temperature behavior have no influence on the accuracy of the measurement.

Typical installation:



Note: Take care that the current through the sensor and the hereby produced power does not influence your measurement. Assure good coupling of the sensor to the media of which you want to measure the temperature and use low currents (1 mA or less).

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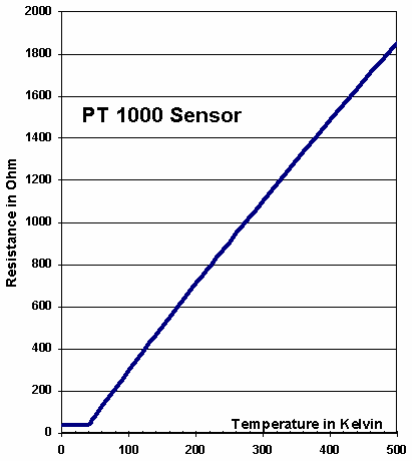
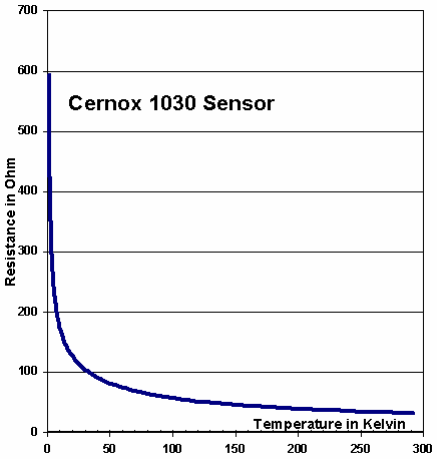
R-T Diagram of a PT1000 and a Cernox 1030 Temperatur Sensor





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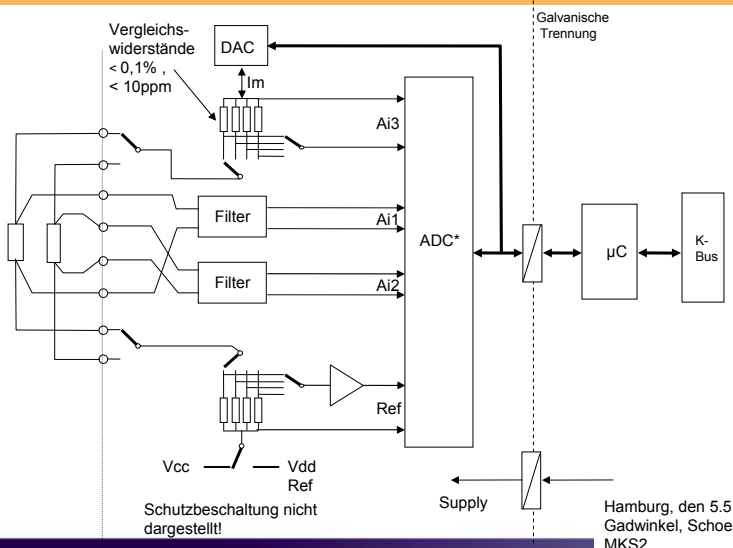
Mögliches Blockschaltbild für 2-Kanal-Version:



Hamburg, den 5.5.2006
Gadwinkel, Schoeneburg
MKS2
DESY, Hamburg

3

Matthias Clausen, DESY
XFEL Cryogenic Control, 23-May-06

*z.B. Analog Devices AD7794

The European X-Ray Laser Project XFEL

Actual Trends in for I/O in Process Controls

- **Most of the sensors actuators are nowadays connected directly to a field bus.**
- **Currently we are testing ‘intelligent’ sensors/ actors which are directly connected to Profibus DP**
- **This will give us a chance to test these devices and the additional possibilities e.g. to use condition monitoring systems based on FTD/ DTM. These systems give access to all individual properties (up to 400) of these devices.**
- **Condition monitoring is a mandatory step towards an integrated maintenance database.**

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Matthias Clausen, DESY
XFEL Cryogenic Control, 23-May-06

Low temperature measurement

A new temperature measurement hardware is in the design phase.

As of today negotiations are taking place with a company to build a modular temperature module which can be connected to the company's filed bus controller. This way we will automatically participate in state of the art field bus technologies.

The module will become part of the standard catalog of the company.

Agenda

- A brief Introduction to Cryogenic Processes
- The HERA Cryogenic Plant
- Process Control Requirements
- Special Cryogenic Measurements and Controls
- **A brief Introduction to EPICS**
- EPICS for Cryogenic Controls
- EPICS for Utility Controls
- Actual Plans for the XFEL Cryogenic Control System
- Outlook
- Summary

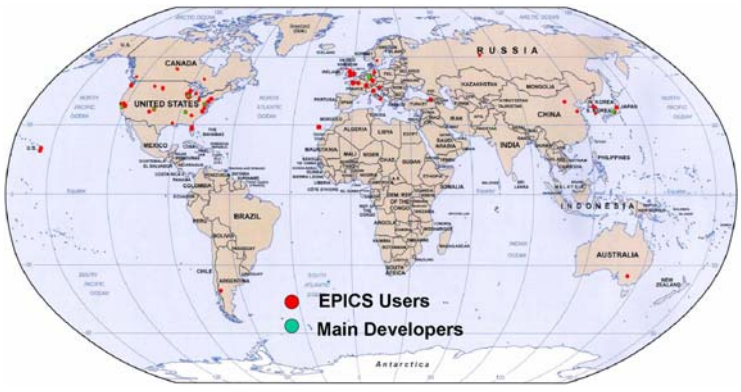
A brief Introduction to EPICS

What is EPICS?

Experimental Physics and Industrial Control System

- **The Collaboration**
- **Basic Concept**
  - Input Output Controller (IOC)
  - Network Protocol (Channel Access - CA)
  - Applications
- **Integration Concepts**

EPICS Collaboration



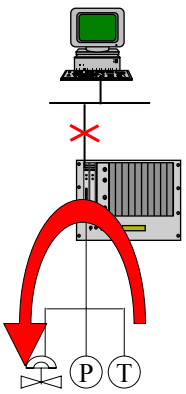
< 2003: 150 EPICS user Licenses

> 2003: open source

EPICS Collaboration: It's the people

Collaboration Meeting Archamps 2005
103 Participants
34 Institutes
4 Companies

EPICS – The Basic Concept



CA-Client
Applications

CA (Channel Access)
- ip-based
communication protocol

IOC
-Control loops
-Sequence programs

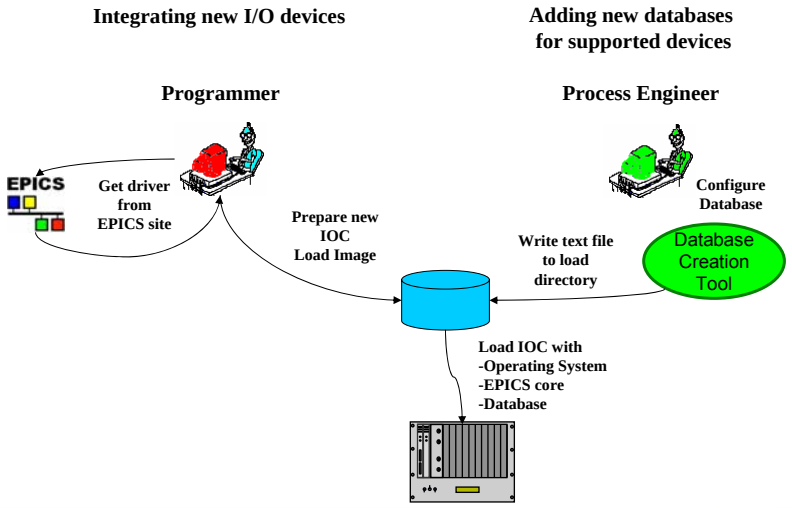
I/O
-Local, or
-On a field bus

CA-Clients
connect to IOC's
via broadcast or name server

IOC Operation
Is independent from
Network Connection

Control Loops
-Permanently running
at sprecise scan time

Application Development

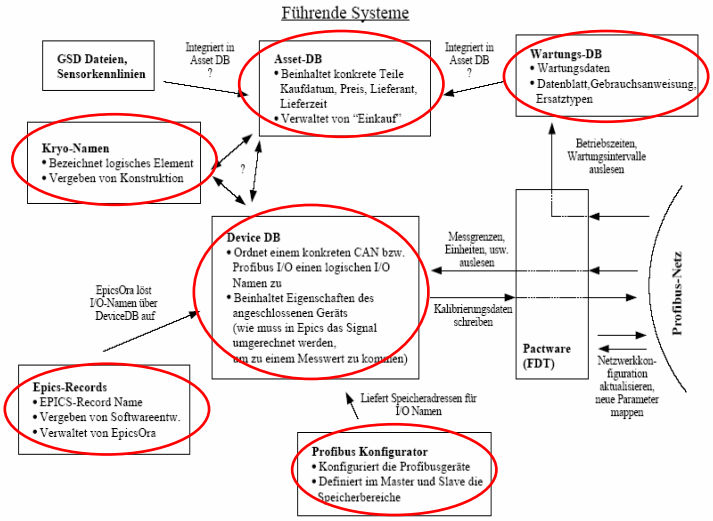


Advantages of the 'EPICS – Way'

- **Code running on the IOC is very stable**
  - EPICS core software developed by core team (specialists)
  - Core is tested on all main operating systems before any new release.
  - Only specialists create new drivers
  - Core and drivers are running in many installations worldwide

    ⇒**Code is well tested and debugged**
- **Process engineers *configure* databases**
  - No code created
  - IOC's only differ by databases – the stable code remains the same
  - Database configuration tools can be used by remote consulting/ engineering companies to create EPICS databases. (Database text files can be send via email to DESY)

Databases



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EPICS for Cryogenic Controls

EPICS fulfills all the requirements of cryogenic control

- **Process control System**
  - Control Loops on IOC
  - Sequencer on IOC
- **Process Control Applications**
  - Synoptic Display
  - Archiver / Viewer
  - Alarm-System / Alarm Display
  - …

Control Implementation

Workstation SNL					
IOC SNL					
IOC Continuous Control					
PLC Logic					
Hardware					
Function	Heater-Control Turbine-Speed	Turn Key Subcomponent	Digital Logic	PID Loops	Sequencer

EPICS desired possible

Performance

- 3000 – 4000 records on a 33 MHz CPU running @ 1 sec is fine
- Several 10‘s records running @ 0.01 sec on a 33 MHz CPU is the limit (lots of task switching)
- Today's PowerPC‘s provide 300MHz or more. Limitations will be given by the I/O throughput not by CPU load or memory consumption

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The European X-Ray Laser Project XFEL

EPICS for Utility Controls

The utility controls group is using EPICS as a SCADA system

- **Configuring EPICS databases**
- **Configuring display files**
- **Configuring alarm configuration files**
- **Configuring archive configuration files**

The utility controls group can use EPICS 'independent' from the cryogenic controls group, which is providing the 'service' to prepare:

- **EPICS applications**
- **EPICS-IOC core software (including drivers)**

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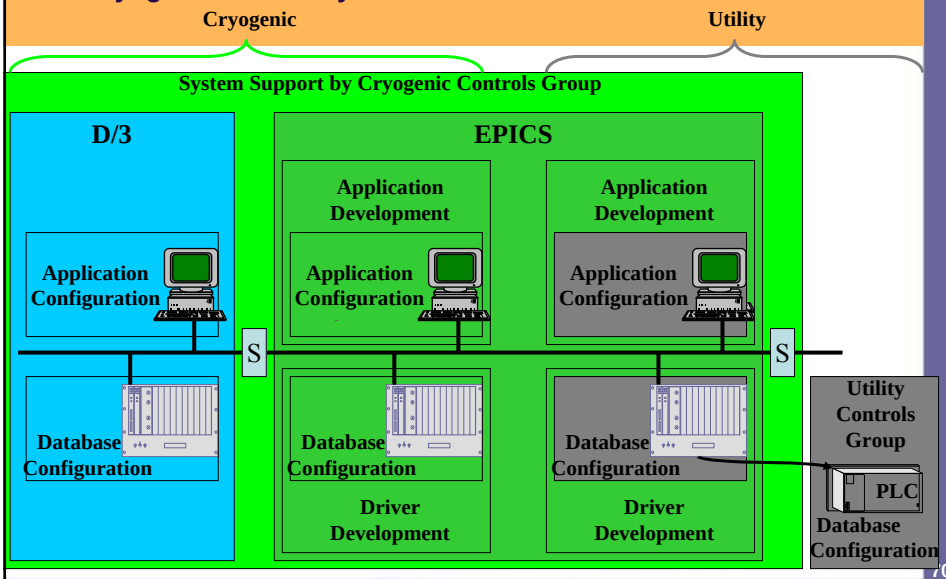
Cryogenic and Utility Controls



Matthias Clausen, DESY
XFEL Cryogenic Control, 23-May-06

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Actual Plans for the XFEL Cryogenic Control System

- **XFEL - Overview**
- **Tentative Time Schedule**
- **Problems ‚to be the first'**
- **Basic Requirements**
- **Basic Designs**
  - Redundant IOC's
  - Redundant I/O
  - CSS – The Control System Studio

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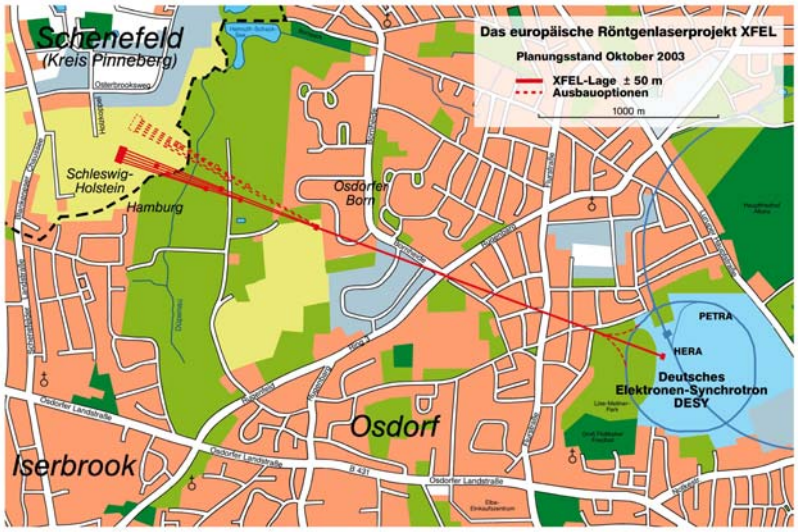
Location



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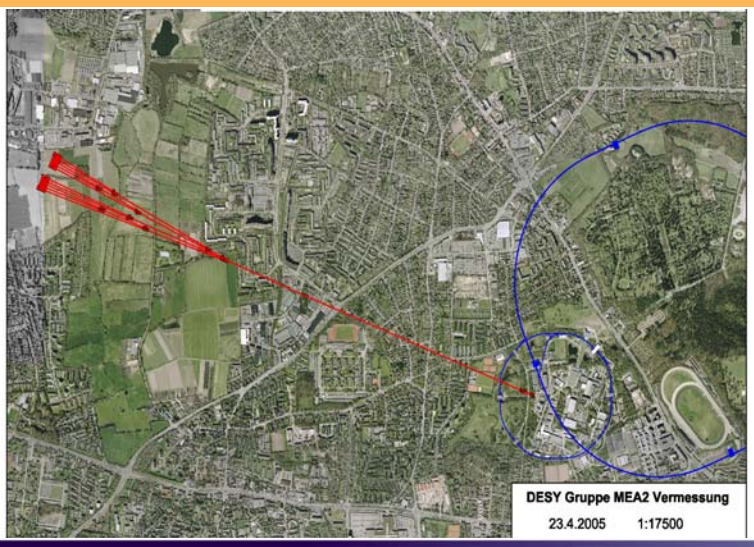

Matthias Clausen, DESY
XFEL Cryogenic Control, 23-May-06

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Acc. layout & parm's cont'd

Energy for 0.1nm wavelength *(max. design energy)*	17.5 GeV *(20 GeV)*
# of installed accelerator modules	116
# of cavities	928
Acc. Gradient (104 active modules) at 20 GeV	23.6 MV/m
# of installed RF stations	29
Klystron peak power (26 active stations)	5.2 MW
Loaded quality factor Q_{ext}	$4.6 \cdot 10^6$
RF pulse length	1.4 ms
Beam pulse length	0.65ms
Repetition rate	10 Hz
Max. average Beam power	600 kW
Unloaded cavity quality factor Q_0	10^{10}
2K cryogenic load (including transfer line losses)	1.7 kW
Max. # of bunches per pulse *(at 20 GeV)*	3,250 *(3,000)* [1]
Min. bunch spacing	200 ns
Bunch charge	1 nC
Bunch peak current	5 kA
Emittance (slice) at undulator	1.4 mm*mrad
Energy spread (slice) at undulator	1 MeV

1) The limitation to 3,000 bunches at 20 GeV beam energy is related to a maximum load of 300 kW on each of the beam dumps in the initially installed two electron beam lines.

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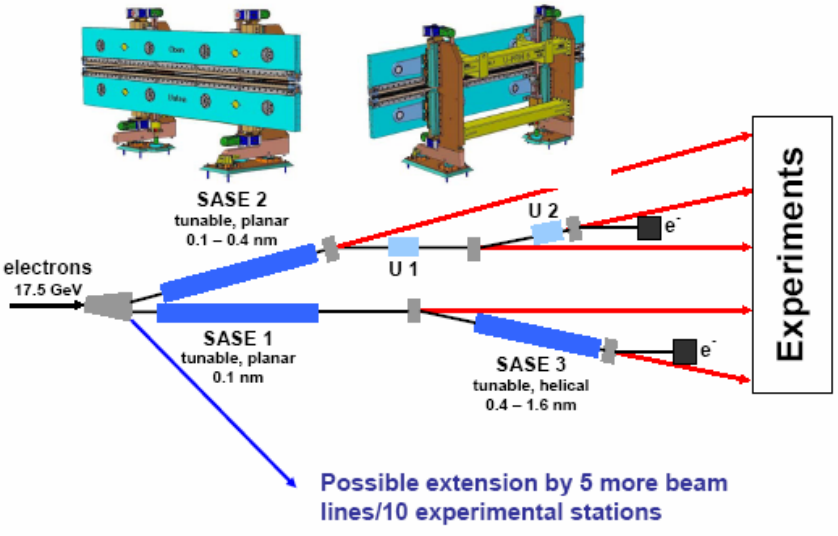
Beam lines



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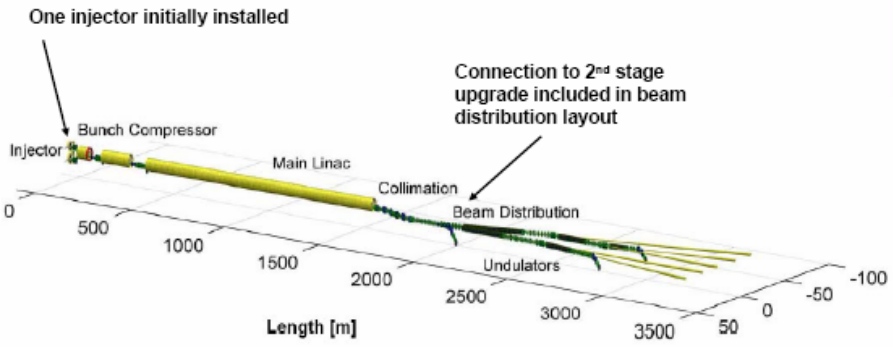
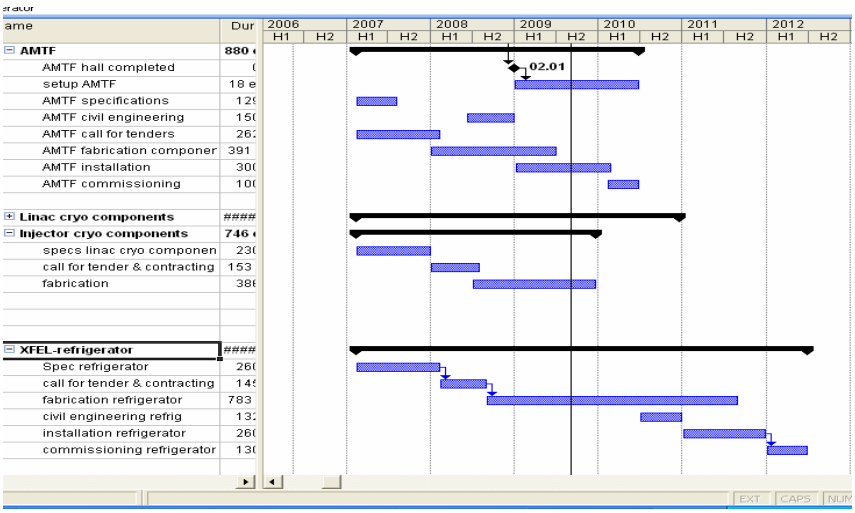
Accelerator layout and parameters

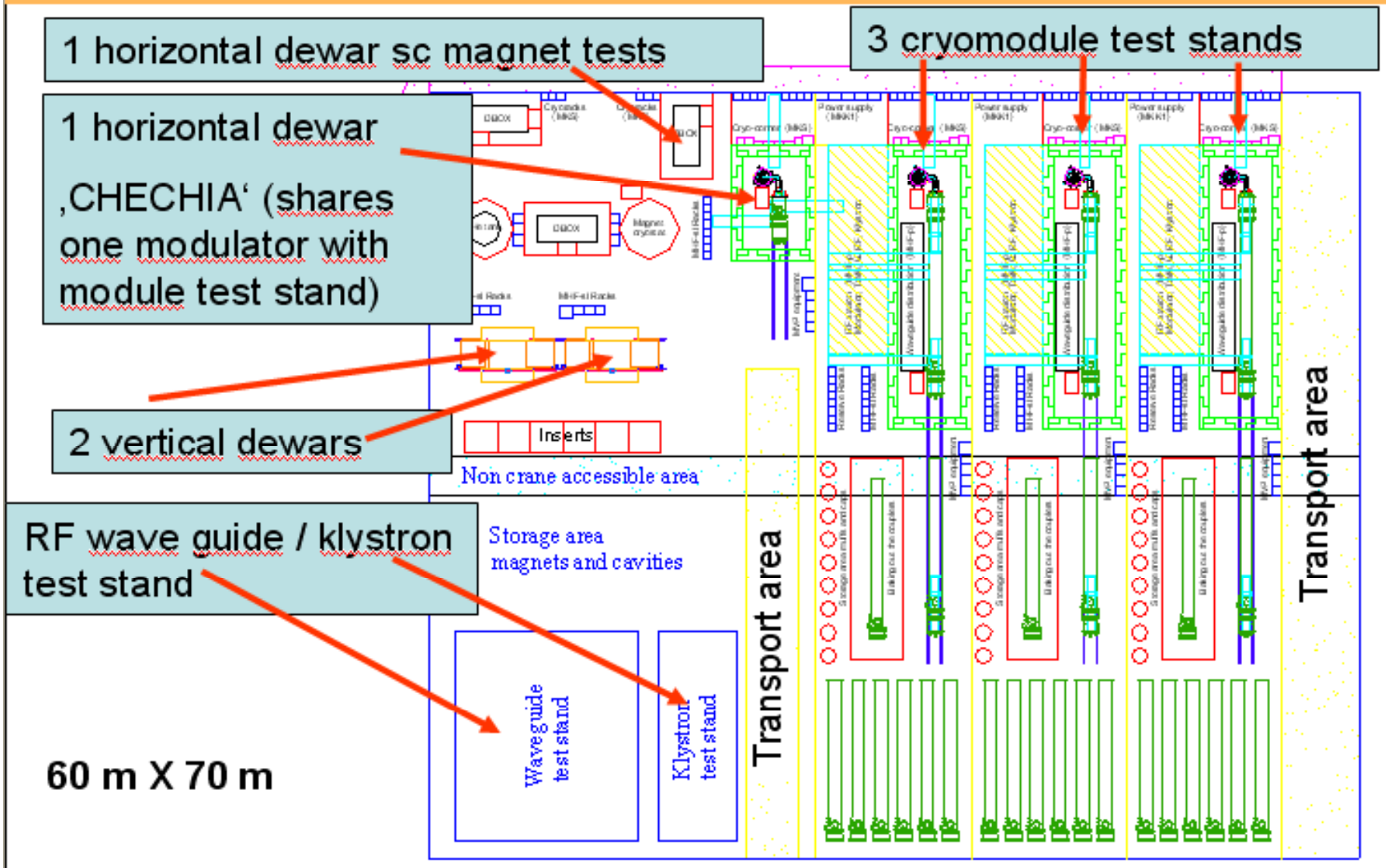


The European X-Ray Laser Project XFEL

XFEL Schedule



Accelerator Module Test Facility (AMTF)



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A M T F - task list

-> performance test of all about 1000 cavities
-> test of 8-12 cavities/ week (in bundles of 4)

-> performance test of all about 120 sc magnet packages
-> test of 1 package / week

-> performance test of all about 120 cryomodules (incl. RF tests)
-> test of 1 cryomodule/ week

One cryomodule will be tested in 12 days (+/- 2 d)

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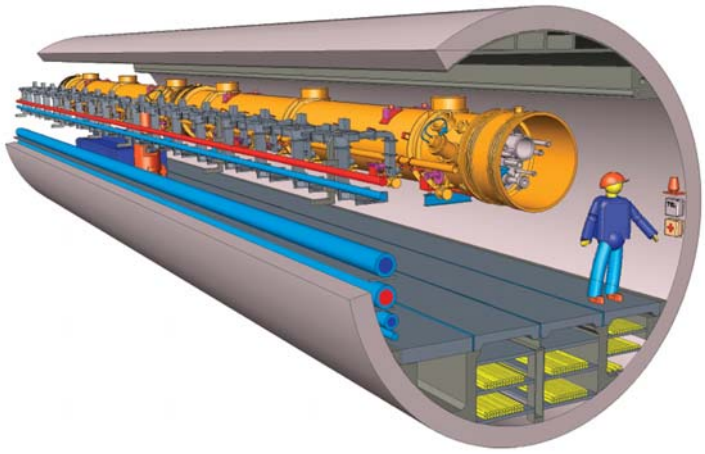
XFEL Tunnel



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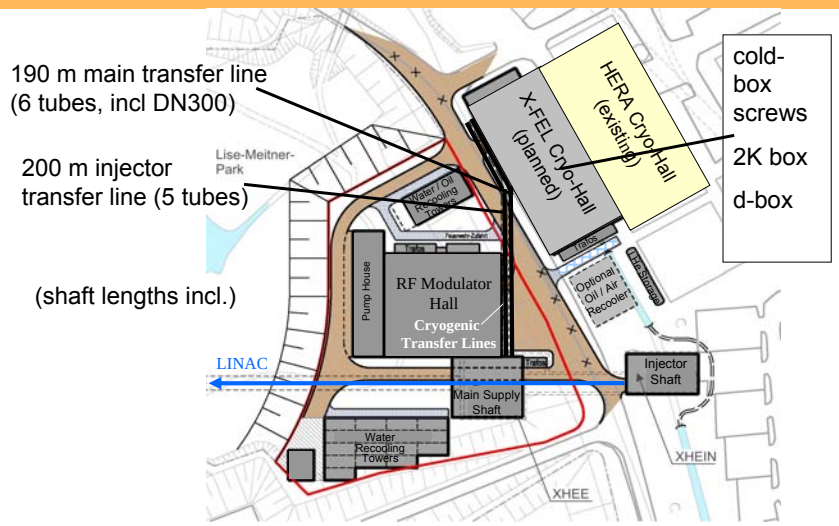
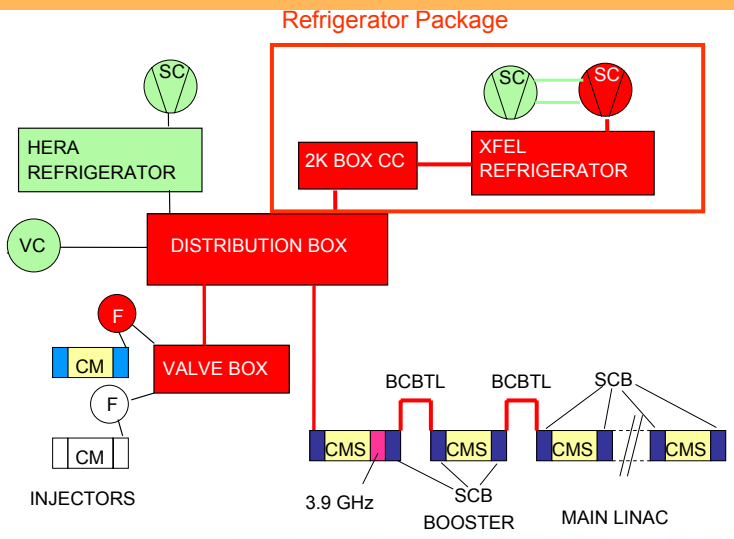
Cryogenic infrastructure



The European X-Ray Laser Project XFEL

Linac cryogenic supply scheme



The European X-Ray Laser Project XFEL

Use of ‚TESLA-Technology‘

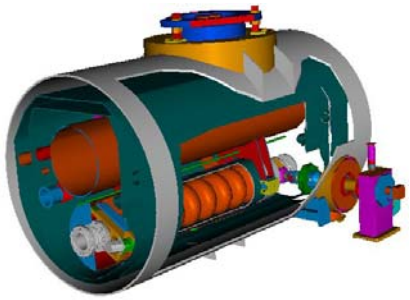
In general, concepts for the cryogenic supply, which were developed for the TESLA linear collider, will be applied

Most of the concepts were validated at the TTF1/ VUV-FEL linacs

Each cryomodule consist of:

- **8 1.3 GHz 9-cell Nb cavities (2K)**
- **1 magnet package (2K)**
- **2 thermal shields (5-8K;40-80K)**
- **8 main RF couplers**
- **8 cold tuners**

23.6 MV/m needed for 20 GeV operation



Cryomodule cross-section

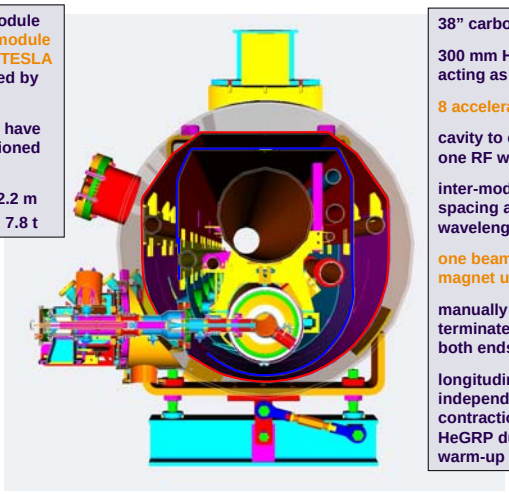
The European X-Ray Laser Project XFEL

Accelerator Module (Cryomodule)

The XFEL accelerator module is based on the 3rd cryomodule generation tested at the TESLA Test Facility and designed by INFN.

Already 10 cryomodules have been built and commissioned for the TTF Linac.

Length	**12.2 m**
Total weight	**7.8 t**



- **38” carbon steel vessel**
- **300 mm He gas return pipe acting as support structure**
- **8 accelerating cavities**
- **cavity to cavity spacing exactly one RF wavelength**
- **inter-module cavity to cavity spacing a multiple of one RF wavelength**
- **one beam position monitor / magnet unit**
- **manually operated valves to terminate the beam tube at both ends**
- **longitudinal cavity position independent from the contraction / elongation of the HeGRP during cool-down / warm-up procedure**

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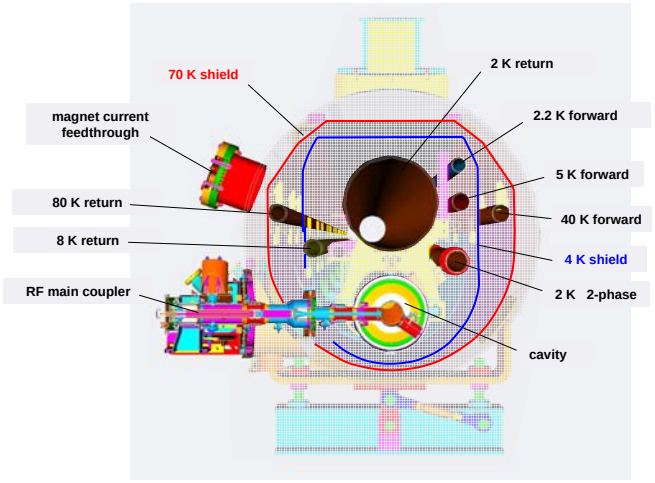
Accelerator Module (Cryomodule)



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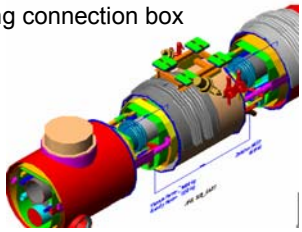
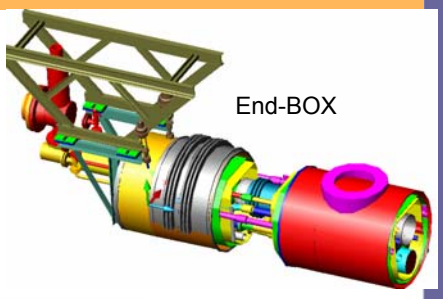
Linac cryogenic components

‚regular' string connection box





End-BOX

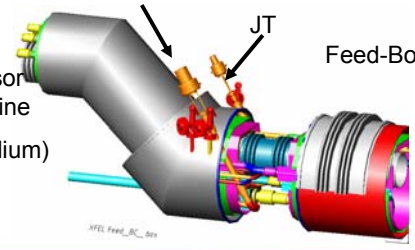
Cool-down/warm-up

JT

Feed-Box

Bunch Compressor
Bypass Transferline

(only 1-phase helium)



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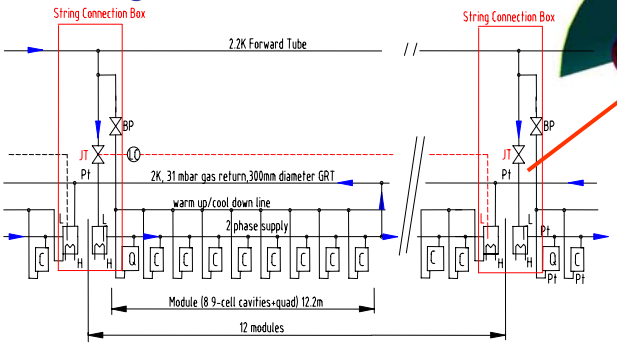
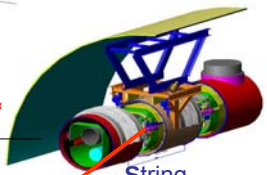
Linac cryogenic ‚string‘

Cryogenic units of 12 cryomodules = ‚strings‘





String Connection Boxes

contain all cryogenic instrumentation

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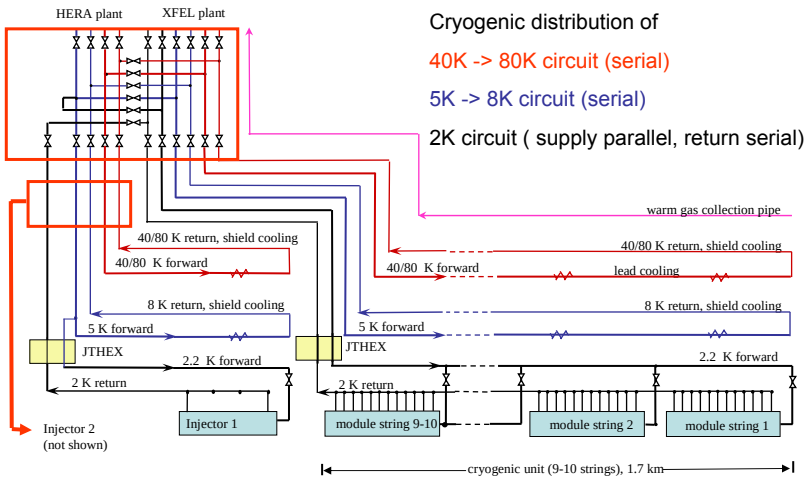
Linac cryogenic circuits



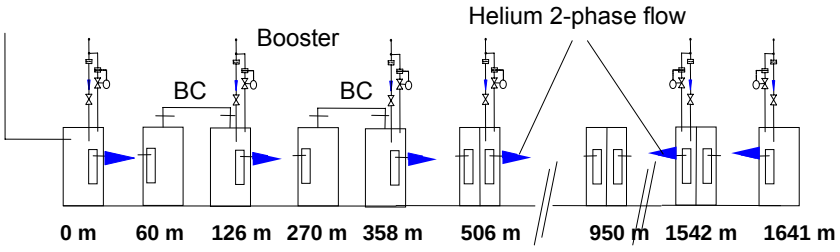
Cryogenic distribution of

40K -> 80K circuit (serial)

5K -> 8K circuit (serial)

2K circuit (supply parallel, return serial)

Matthias Clausen, DESY
XFEL Cryogenic Control, 23-May-06



Beam direction

Laser-straight

1000 m

Gravity equipotential surface

XFEL Controls Demands

A user facility with high demands for 99.8% efficiency

- The control system may not fail
- Possible scenarios:
  - ⇒ **Hot stand by (seamless switch of IOC's)**
  - ⇒ **Cold stand by (switching ‚on demand'; i.e. for maintenance)**
- Biggest problem: Find radiation hard electronics for the tunnel
  - ⇒ **Distributed redundancy in cold stand by may help**
  - ⇒ **Most sensors and actuators contain electronics nowadays.**

The European X-Ray Laser Project XFEL

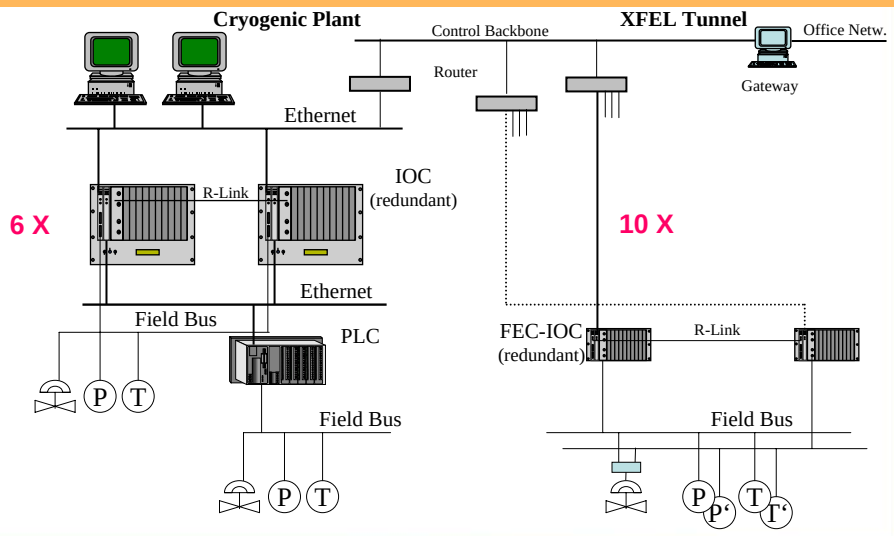
Fulfilling XFEL Control Demands

Redundant Process Controllers will help to provide the required MTBR. The following actions can be performed without interrupting cryogenic operations:

- **XFEL Cryogenic Plant:** ***Main objective: Maintenance*** **(permanent operation for more than one year)**
  - Hardware maintenance
  - Software maintenance
  - Installing new system-/ application- Software
- **XFEL Tunnel Installation:** ***Main objective: Survive radiation damage*** **(MTBR > 1 month)**
  - … same like cryogenic plant
  - Seamless switch over of:
    - ⇒ **Process Controller (IOC)**
    - ⇒ **I/O sensor/ -actor**
    - ⇒ **Power supplies**

The European X-Ray Laser Project XFEL

Principle Layout of the XFEL Cryogenic Control System



Redundancy: New developments

The implementation of the key redundancy tasks on an IOC has been subcontracted to two companies:

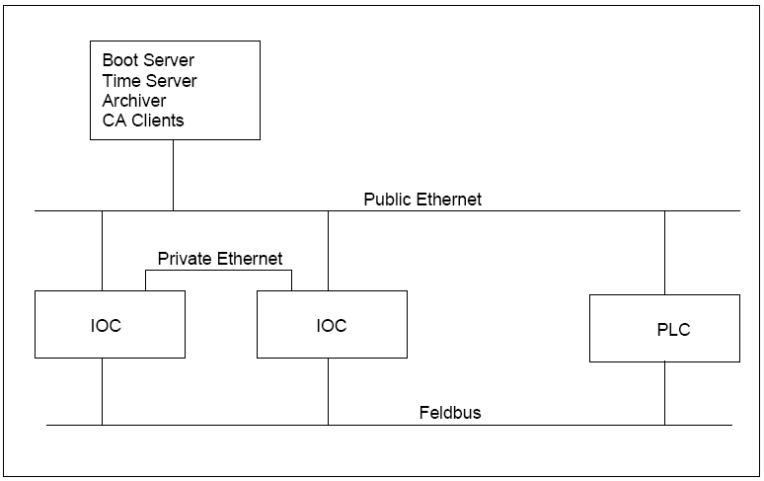
- **Redundancy Monitor Task**
  - Supervision of the tasks running on an IOC
  - Switching IOC's in case of serious problems on one IOC
- **Continuous Control Executive Task**
  - Synchronizing the continuous control processing on two IOC's
  - Permanent monitoring of all changes in record processing on an IOC

Core and main objective of any failover:

The resulting status of an IOC after a failover must be a more stable state than the status before the failover.

- Diagnostic analysis programs must be activated to ensure this.

Redundancy Monitor Task (RMT) Hardware Layout



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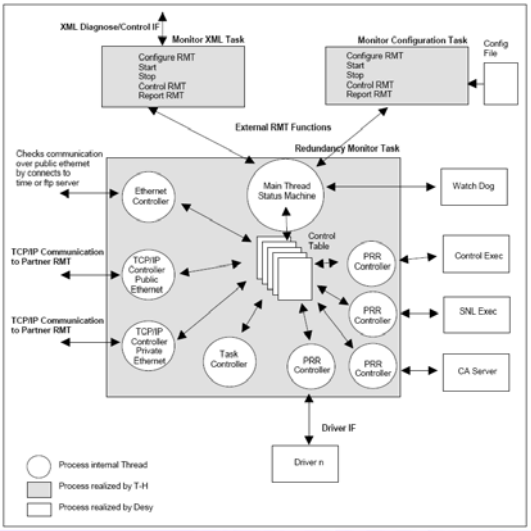
Redundancy Monitor Task (RMT) Process and Interface Design



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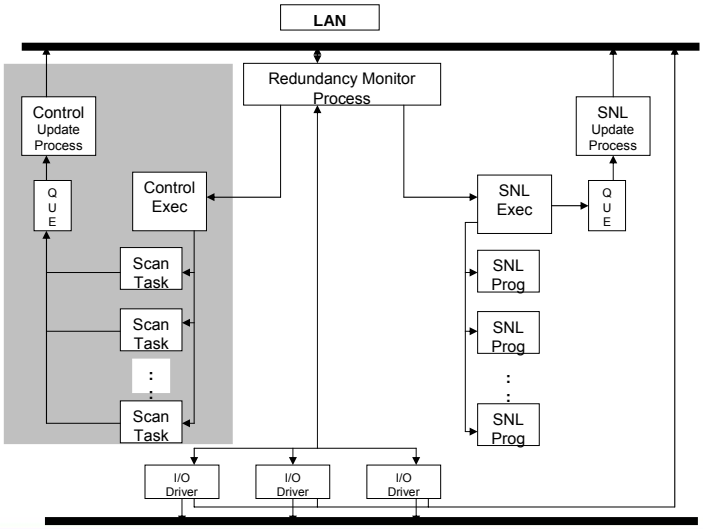
Redundancy: Control Executive



Matthias Clausen, DESY
XFEL Cryogenic Control, 23-May-06

New Operator Displays for the XFEL Cryogenic and Utility Control Systems

Motivation for a new application suite

- **The existing applications (mainly written in X-Window) run (nearly) only on Unix machines.**
- **There are only a few programmers (left) that know how to program X-Window/ Motif**
- **The new EPICS Version will provide new features that must be supported also by the applications**
- **The existing applications are similar to the first set of Microsoft applications.**
  They do not share a common look and feel.

What is the Control System Studio (CSS)?

It is an environment / framework which enables you to create your control system applications.

It shall offer a common look and feel for all applications

It shall provide interfaces to:

- Control System Data
- Control System Name Services
- Control System Logging Services
- Application Logging Services
- Application Management Services
- … more

It shall provide a generic infrastructure to built pluggable, component based applications:

- High level applications (XAL)
- User/ operator applications

The selected Environment

Language:

- Java

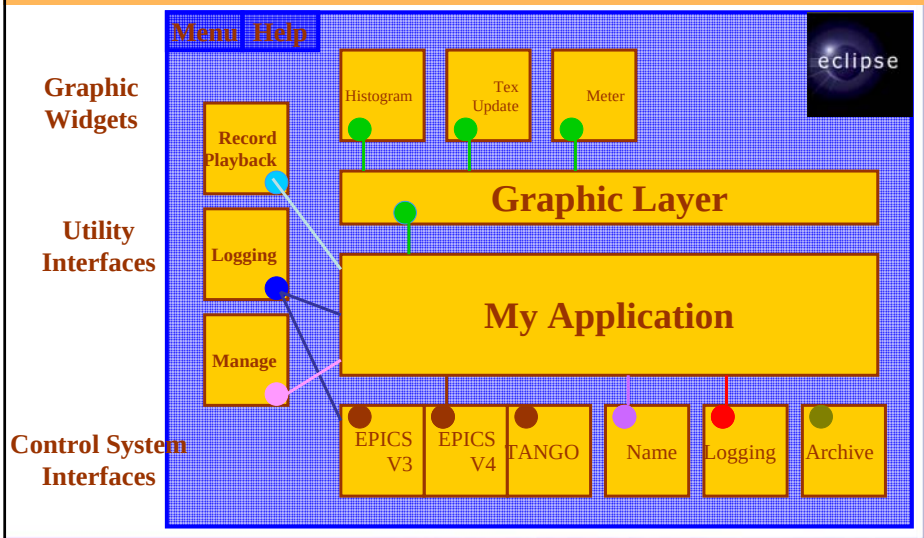
Development environment (IDE):

- Eclipse

Proposed Rich Client Platform (RCP):

- Eclipse

CSS – Framework
in Eclipse (as a RCP)



Collaboration/ Contracts with Companies

We do not have the necessary manpower and not the necessary experience to develop such a framework all on our own.

We are working together with competent partners:

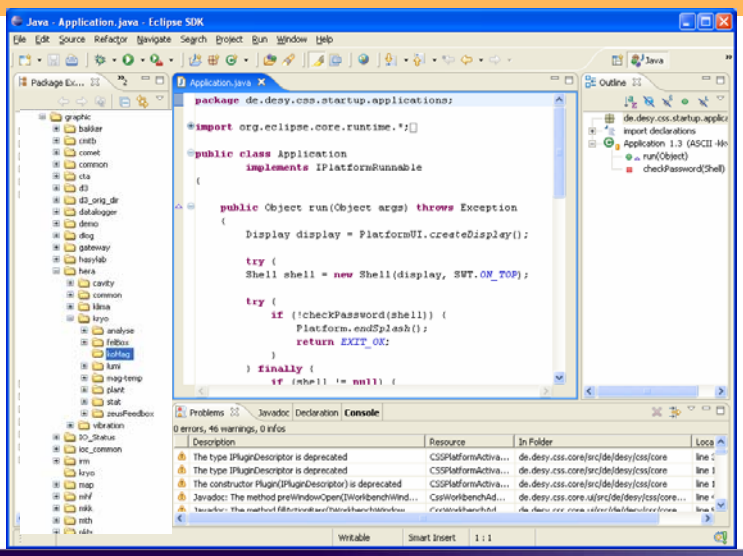
Utility Interfaces and overall Design:

- C1 WPS GmbH, Hamburg

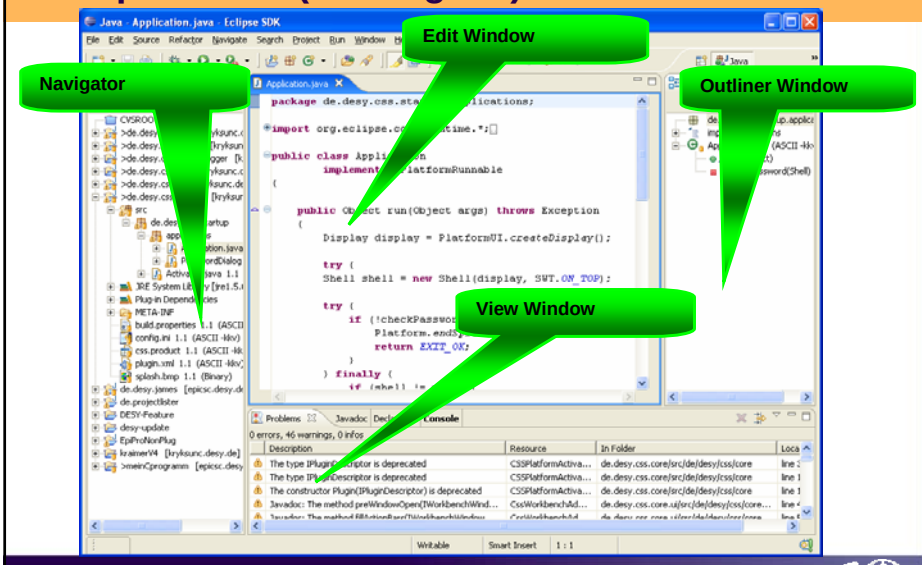
Control System Interfaces:

- Cosylab, Ljubljana (Slovenia)

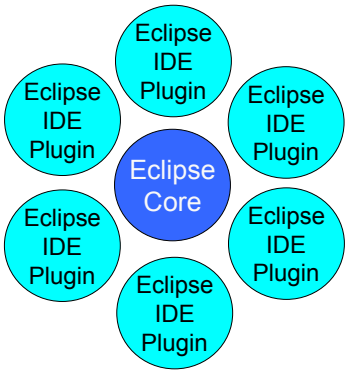
Eclipse IDE - (the original)



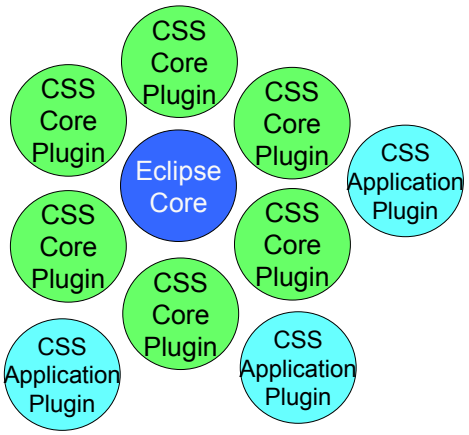
Eclipse IDE - (the original)



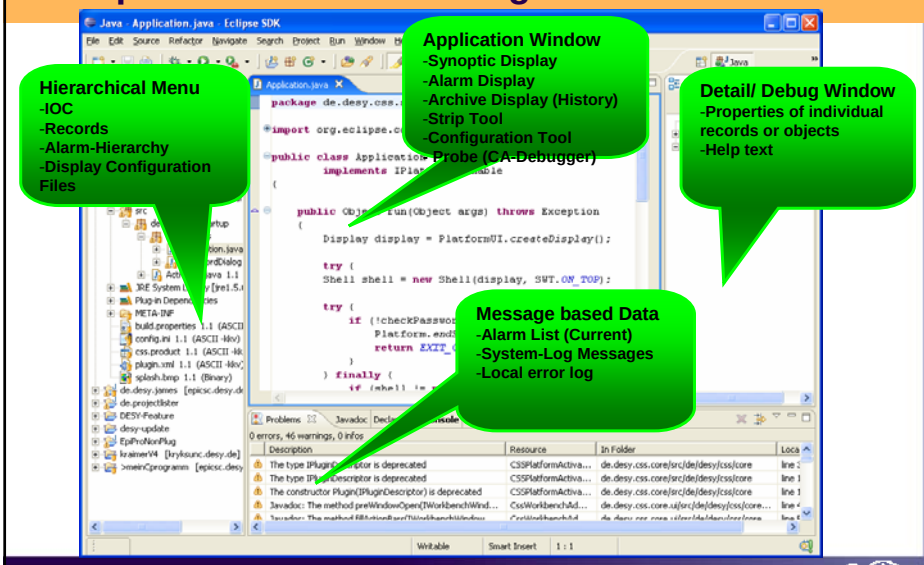
Eclipse to CSS evolution from Eclipse …



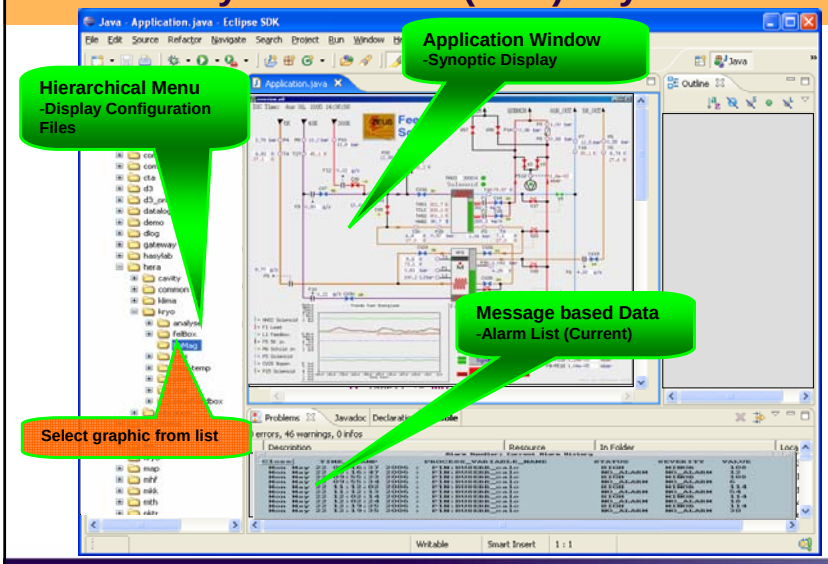
Eclipse to CSS evolution to CSS …



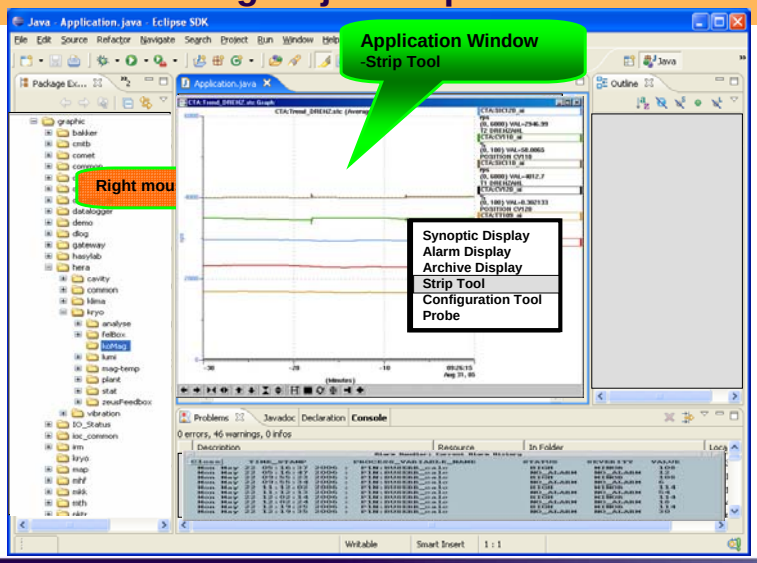
Eclipse IDE / new meaning for CSS



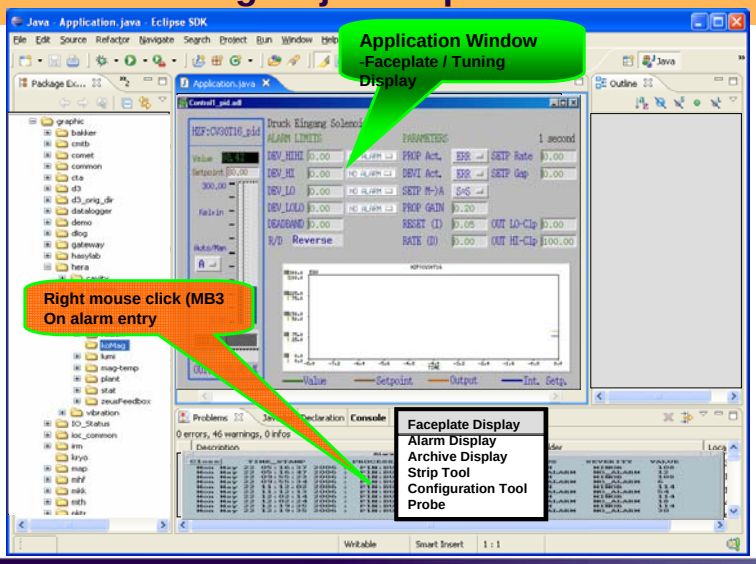
Control System Studio (CSS) Layout



CSS – selecting Object Aspects with MB3



CSS – selecting Object Aspects with MB3



CSS Status

CSS Frame Application is implemented (V0.1)

Implemented Interfaces:

- **Logging**
- **Help**

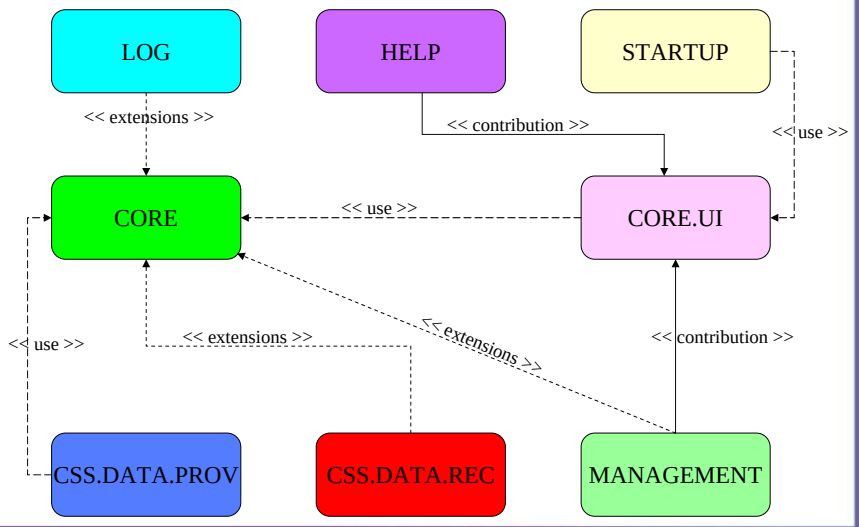
Specified Interfaces:

- **Data Interface**
- **MB3 Extension point**
- **Authentication**
- **Authorization**

Interfaces 'in the works'

- **Management (update services)**
- **Drag and Drop Data Type (for 1D, 2D, 3D data)**

CSS – in the short pipe



Agenda

- A brief Introduction to Cryogenic Processes
- The HERA Cryogenic Plant
- Process Control Requirements
- Special Cryogenic Measurements and Controls
- A brief Introduction to EPICS
- EPICS for Cryogenic Controls
- EPICS for Utility Controls
- Actual Plans for the XFEL Cryogenic Control System
- **Outlook**
- Summary

Outlook

The new developments for the XFEL Cryogenic Control System are on the way.

No show stoppers occurred so far.

- **Redundancy developments will be finished by the middle of this year (2006)**
  - Intensive test will follow.
  - The expected test period is about one year until 'production' code can be released.
  - Production code will be tested at the existing CMTB (Cryo Modul Test Bench) and will be available for the AMTF (Accelerator Module Test Facility) prior to XFEL operation.

Outlook - II

- **CSS developments will be carried on with the industrial partners and with several contributions from the EPICS community.**
  - Partners for individual developments have confirmed their interest/ are already working on CSS:
    - ⇒**Drag and Drop Data Types (DaDDT) Tony Lang – Australia**
    - ⇒**Archive display: Sergei Chevtsov – SLAC**
    - ⇒**Database integration: TBA**
    - ⇒**Synoptic Dislay: Yuri Smirnov – DESY**
  - The CSS core will be available this summer
  - Developers can start building their applications on top of the CSS framework

Agenda

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Summary

Cryogenic Controls are – besides Utility Controls – the first controls applications that must be in place far before the machine control system gets installed.

The Utility Control Systems for the XFEL (Cryogenics, Power, Water, Air, Air-Conditioning…) have decided to use EPICS for their controls purposes. The successful collaboration between the two groups will be continued for the XFEL.

Basic designs for the XFEL Utility Control Systems have been started in time to provide all the necessary services for XFEL operations.

References

I thank the following colleagues for their slides:

Udo Wagner (CERN)

Bernd Petersen (DESY)

Reinhard Brinkmann (DESY)

Interested partners are always welcome to join the team!

http://css.desy.de
http://elogbook.desy.de:8081
http://epics.aps.anl.gov/epics/
http://epics.desy.de

cvs repository:
kryksunc.desy.de
/afs/desy.de/group/m/mks/cvs