SCRF Infrastructure at CERN?

Electron Accelerator R&D for the Energy Frontier

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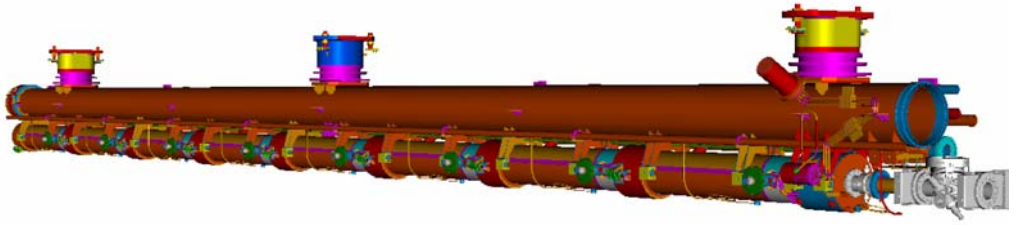
DESY –MPY-

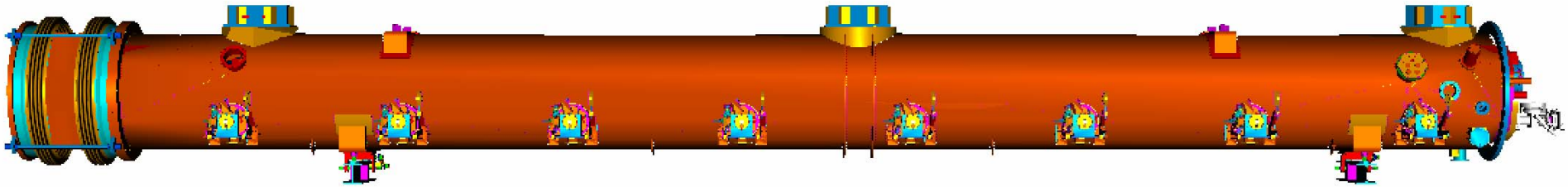
Overall Framework

- GDE Discussions
  - Effort needed
    - To make ILC-gradients more reproducible
      - Any step in Europe should be integrated in the larger R&D framework
    - Step toward a integrated systems test
      - At least the size of one RF unit, which determines the number of cavities to at least 30
    - Knowledge transfer to industry
      - Large contribution of the XFEL
      - But: the XFEL will not have the time to explore all the parameter space (see below)
- FP7 preparation
  - Come to some conclusions here

Primary goal:
Production of ILC prototype modules (4th generation) in Europe

- Scope
  - Should include building all parts
    - Cavities
    - Couplers
    - Magnet
    - BPM
    - Cryostat vessel
  - Must include a next generation cavity preparation facility
    - Improve processes
    - Avoid bottlenecks





Cavity Preparation Infrastructures Today

- Some infrastructure is available in Europe (not only DESY)
- Most setups are still R&D size
  - Often single-cell cavities
  - Small through-put
- Single-line of processing
  - No redundancy
- Have come to age
  - Materials
  - Overall layout needs significant re-work with today‘s knowledge
    - Electropolishing as the baseline process
    - required number of high pressure water rinses

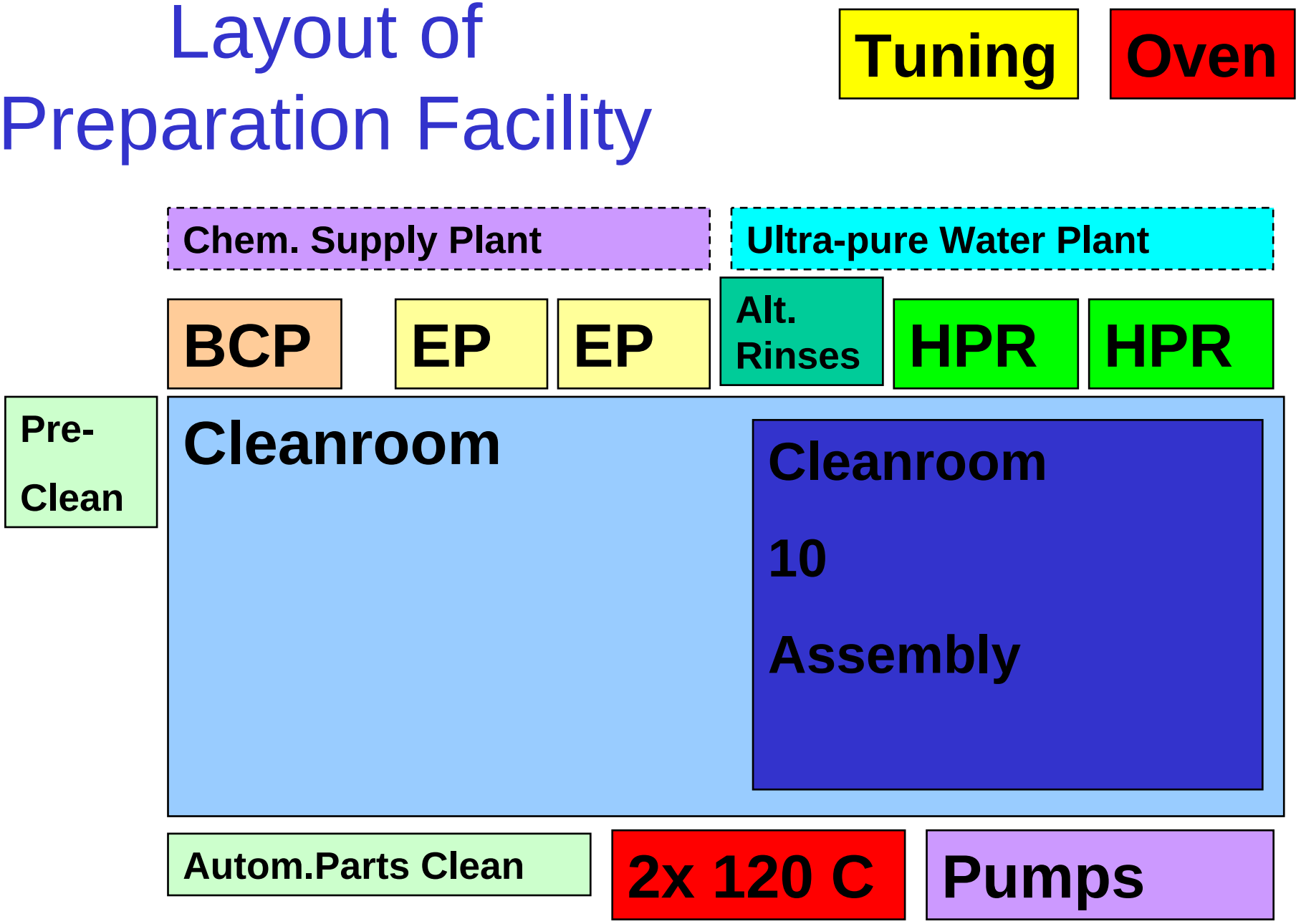
Next Generation
Cavity Preparation Infrastructure I

- Main Features
  - Improved electropolishing
    - Focus to avoid sulphurus contamination
    - Redundancy
  - Improve Final cleaning
    - Flexibility needed here e.g. alcohol rinses
  - High pressure rinse (HPR)
    - Online particle count integrated in drain water line
    - Redundancy
  - Cleaning of parts
    - Automation needed: screws used as example
  - Improved/novel methods of QA/QC

Next Generation Cavity Preparation Infrastructure II

- Modular setup
  - Institutes get responsibility for part of the process (HPR design, EP design etc.)
- Redundant setup
  - 2 x EP,
  - 2 x HPR,
  - 2-3 120 °C bakeout stations
- Other infrastructure
  - Etching needed (e.g. outside cleaning)
  - designated 800°C furnace
  - Sufficient pump stations, etc.
- Opional
  - Dry-ice cleaning
    - Needs feasibility demonstration

Layout of Preparation Facility



Implementation of a Facility

- Location Alternatives:
  - Makes sense to site this at existing TTF infrastructure here at DESY.
    - Additional manpower would be a pre-requisite
  - CERN
  - Available (needs check):
    - 2K cryogenic-infrastructure
    - Vertical Teststands
    - Module Teststands (How many?)
    - Single-cell preparation infrastructure?
    - Surface science department in-house
    - Manpower ?
  - Needed
    - Infrastructure for multi-cells with redundancy
    - RF Power
- Manpower
  - Qualified manpower is a critical issue on all levels (engineers, technicians)
  - How ‘free’ could this expertise be in 2008+?
  - How much additional manpower could be made available?

Sketch of possible programme:

- Component design in framework of world-wide effort
  - Some design work might be finished by 2007 e.g. cryostat vessel
  - but this should not stop people stop from thinking about sub-components like magnet and cold BPM
- Details…

ILC Cryomodule Design

- Goals
  - 4th generation module
    - Quadrupole in the center
    - Shorter cavity spacing
  - Module assembly capability
  - Module testing capabilities
  - Prototyping of cryostat vessel in European industry
- Implementation:
  - Finish design work as collaboration of FNAL, INFN, DESY,..
    - ILC design finished in 2007?
  - Assembly of modules
    - Need a cleanroom for string
      - » Could use refurbished CERN cleanroom in SM18
      - » could be at TTF?
  - Test facility without beam
    - Could refurbish CERN infrastructure in SM18
    - Could be extension to XFEL module test hall, then use single module test stand for ILC
  - If Beam test is needed somewhere (e.g. HOM damping), could be just a probe beam.

High-quality cavity production and preparation including full-power test

- Cavity design
  - Goals:
    - Compact with shortened beam tubes
    - Cavity shape options
      - Standard
      - Low-Loss
  - Implementation
    - ILC LL
      - complete design available done at SLAC, DESY and others
    - Initial tests will be available
- Material options
  - Goals:
    - Large-grain or single-crystal
    - Standard material
  - Implementation
    - Built 30 ILC-cavities and test

High quality cavity production ctd.

- Cavity preparation
  - Goals
    - Improve preparation process
      - Improve EP (is a must…)
      - Etching needed (e.g. outside cleaning)
      - Improve Final cleaning
      - High pressure rinse (HPR)
        - » Online particle count integrated in drain water line
      - Dry-ice cleaning?
        - » Needs feasibility demonstration
      - Cleaning of parts
        - » Automation needed: screws used as example
      - Improved/novel methods of QA/QC
  - Implementation
    - Setup of new infrastructure
      - » DESY: Independent of TTF
      - » CERN: partial refurbishment might be an option
    - Modular setup
      - » Institutes get responsibility for part of the process (HPR design, EP design etc.)
    - Redundant setup
      - » 2 x EP,
      - » 2 x HPR,
      - » 2-3 120 °C bakeout stations
    - designated 800°C furnace
    - Sufficient pump stations, etc.

High quality cavity program ctd.

- Cavity testing capabilities
  - Goals :
    - Low-power and high-power individual cavity tests
  - Implementation
    - DESY: Extension of XFEL infrastructure or use TTF
    - CERN: Make SM18 1.3GHz compatible
      - Minor work cryostats
      - Improve pumps for 2K ?
      - RF system esp. for Pulsed operation
        - » obtain MBK from America

Cavity Auxiliaries

- TTF-III coupler
  - Goals
    - Lower cost
    - Even faster processing
  - Implementation
    - Continue work at LAL Orsay
    - Full synergy with XFEL
- Compact Tuner design
  - Goals
    - Develop compact tuner
    - Including fast tuning (e.g Piezo)
  - Implementation
    - Blade tuner at INFN
    - Compact lateral tuner at Saclay ? – needs confirmation

ILC magnet design

- Goals
  - Full design to ILC specs
  - Follow discussions on ILC issues
- Implementation
  - Continue work with CIEMAT
  - Acquire magnets in America?

ILC BPM design

- Goals
  - More compact re-entrant
  - Eventually integrated (closely attached) to quadrupole
- Implementation
  - Basic layout XFEL-like ?
    - XFEL Resolution insufficient for ILC
    - Continue CEA work
    - Need compact design

Time scales:

- >2008
  - Time scale would have this infrastructure running parallel to XFEL cryomodule production, which could provide ‘mass production’ feedback for foreseen ILC program.
  - some of the design work will be done until end 2007 by ILC worldwide
  - setting up of preparation infrastructure is most time-consuming
    - if parts of TTF infrastructure can be used the cavity preparation can be started earlier
    - at CERN the adaptation of the infrastructure needs to be cross-checked but should be rather straight-forward

Money Scales

(Warning: My Guess!)

- potential amount 30 MEUR (greenfield site)
- Collaborations will probably still require to support 50% of the activities.
- Budget would be allocated for
  - New cryostat vessels
    - Up to 3 modules
  - new cavities (>30)

  } 6 MEUR
  - auxiliaries
  - new infrastructure
    - RF — 2 MEUR
    - Cryogenics
      - » Plant — 5 MEUR
      - » Cryostats +low-power RF — 5 MEUR
    - Cleanroom (min.2 HDs) — 4 MEUR
      - » Assembly tooling — 1 MEUR
    - Chemistry — 3,5 MEUR
      - » EP (2 benches)
      - » Etching
    - Furnace min.800°C — 1 MEUR
      - » Extras — 5 MEUR
    - manpower (new people)

For Discussion…

- I see two possibilities for such a facility
  - CERN refurbishment
    - Some construction work needed
  - DESY would need new construction and significant manpower
    - Cavity testing might start earlier by using existing facilities
- A participation by collaborating institutes are hardware (e.g. EP system) and/or people
  - Possible integration of industry
- Other cavity shapes (e.g. for protons) could be integrated in case treatment modules are supplied
  - Use of water and chemical plant is straightforward

Conclusion

- Such a facility is needed
- CERN is a clear option as some (costly) part of the infrastructure is there
  - Not to be forgotten: Some Know-how as well!
  - DESY can be an alternative
- Evaluation is needed on who can provide what