Industrial involvement in planning for X-FEL (TESLA)

• Contracts to industry for costing of components
  – Planning, layout & operation of fabrication facilities for major linac components (“study by industry”)
  – Prototype development

• Cooperation with industry
  – Feedback from fabrication of TTF components
  – Proposals for cost saving in fabrication
  – Engage new companies in TESLA technology
  – Implementation of EDMS system
Contracts to industry for evaluation of fabrication ("industrial study")

- **Analyze present production of TTF components**
  - Describe present fabrication process
  - Determine cost drivers, critical procedures
  - Define core technology, outsourcing possibility

- **Implementation of mass production methods**
  - Evaluate investment of machinery, tooling, roboting
  - Cost optimize flow of fabrication
  - Describe layout for "core tech" factory
Contracts to industry in cost evaluation, ("industrial study"), cont.

- **Complete planning of new “core tech” factory**
  - Determine costs for buildings, investment, man power, ramp up & production & ramp down, overhead, consumables, QC,…
  - Get bits for outsourced parts
  - Sum up total cost of component fabrication
Industrial evaluations

- **Cavity fabrication (welding) for TESLA**
  - Noell (Dornier- Astrium),

- **Cavity preparation and module assembly**
  - Noell,
  - ACCEL

- **Niobium production for TESLA**
  - Noell (W.C.Heraeus)
  - H.C.Stark (under test sheets production)
Standard Cavity Production, welding

Symposium, D.Proch, DESY
Cavity Prototype production cost

- Machining: 35%
- Welding: 49%
- QA: 4%
- Chemistry: 6%
- Administration: 3%
- Consumables: 2%
- Storage: 1%

SFR 2005, Industrialization Symposium, D.Proch, DESY
Reduction of fabrication cost

• 3 chamber welding machine:
  – Pump down and cool down in separate chamber
  – Welding in middle chamber

• Tooling for welding many parts in one cycle

• Outsource machining of parts
Cavity mass production cost breakdown

- Machining: 77%
- Welding: 10%
- QA: 4%
- Chemistry: 4%
- Administration: 2%
- Consumables: 1%
- Storrage: 2%

SFR 2005, Industrialization Symposium, D.Proch, DESY
Cavity preparation, Cryostat and Assembly

• X-FEL cryo-modules are based on the 12 m TTF modules

• Two industrial investigations
  – Cavity preparation and module assembly by
    • Babcock Noell Nuclear
  – Vacuum vessel and cold mass by
    • ZANON
Cavity Preparation; String and Module Assembly
Cavity preparation, Cryostat and Assembly, cont.

- Major cost drivers are
  - Cavity heat treatment (1400°C) :
    investment and operation costs
  - Module assembly:
    man power

→ New study under preparation to optimize the cryostat assembly procedure
Niobium for ILC (TESLA)

• Production of 500 tons of high purity Niobium (RRR300) in 3 years
  – Total World production of Nb is about 40,000 tons
  – But critical step for high purity Niobium is high vacuum electron beam melting
  – Only one company (Wah Chang) has melting capacity for total demand, two other (Tokyo Denkai, Heraeus) can make 30%
Niobium for TESLA, cont.

• Offer for large quantity of Niobium for TESLA showed only moderate mass production saving. Why??
• High quality of Niobium is crucial for TESLA cavities
  – In depth understanding of production is desirable
• ==> Planning, layout & operation of a new fabrication facility
  – Defined all process parameters
  – Planning for a new melting company
  – Total cost evaluation
Produktionsanlage zum Umschmelzen
High purity Niobium production

- Melting: 49%
- Raw material: 21%
- Rolling: 17%
- Firing: 7%
- Forging: 3%
- Chemistry: 2%
- Scrap: 1%

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Conclusion of Nb production evaluation

– Overall financial effort is 88% of TDR costs

– Costs are dominated by melting investment, longer production time could lower the costs