

Cryo-module cost drivers and industrialization

- Short report on first industrial study on module assembly (TESLA effort)
- Motivation for the second industrial study (X-FEL)
- Detailed info about the second study

First series of industrial studies (TESLA effort)

- **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, robotics
 - Cost optimize flow of fabrication
 - Describe layout for “core tech” factory

First series of industrial studies (TESLA effort) cont.

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

Industrial studies (TESLA effort)

- **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)

Major results of study for Cavity preparation, Cryostat and Assembly

- 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**

New Industrial Study : X-FEL Cryomodule Design & Assembly

Part of EUROFEL Design Study Workpackage DS6

BESSY and DESY are partners in DS6

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Motivation

Preparation of the **European XFEL-Project** and other superconducting linac based FEL-light sources like the **BESSY FEL**

In particular, preparation of the serial production of about 120 XFEL-cryomodules for the European XFEL-Project

Input for the final design and assembly procedures for the XFEL-cryomodules

Each cryomodule consist of:

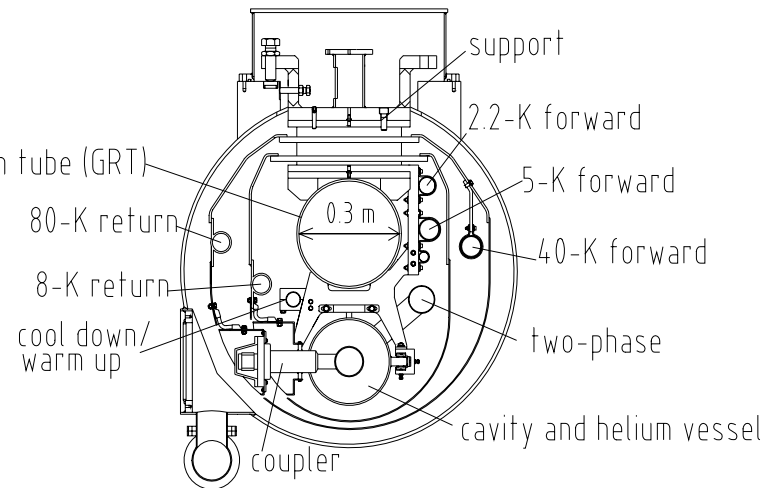
8 1.3 GHz 9-cell Nb cavities

1 magnet package

2 thermal shields

8 main RF couplers

8 cold tuners



Scope

The present **cryomodule assembly procedures** and some aspects of the **present design** shall be analyzed and questioned with respect to the most cost effective serial production.

The **key aspects** of the study are as follows:

1.2.1 Define the **assembly procedure**

1.2.1 Analyze **cost-reduction** and production efficiency measures

1.2.3 Analyze **performance improvement** measures

1.2.4 Supply a **cost estimate** for the module production

A substantial part of the IS shall be the **presence of CONTRACTOR's experts** during the assembly of two prototype cryomodules at DESY.

Cryomodule Assembly

the study shall cover clean room assembly and the assembly outside cleanroom

Startpoint: string assembly in cleanroom

(all parts are tested and ready for assembly)

Clean room assembly



Assembly outside cleanroom



Prerequisites of the CONTRACTOR (key technologies)

- 1) Experience of **serial production** of large Particle Accelerator Components.
- 2) Experience of design and construction of **Cryogenic** Components used at liquid helium temperatures.
- 3) The **Know-How of industrial serial production** at hand.

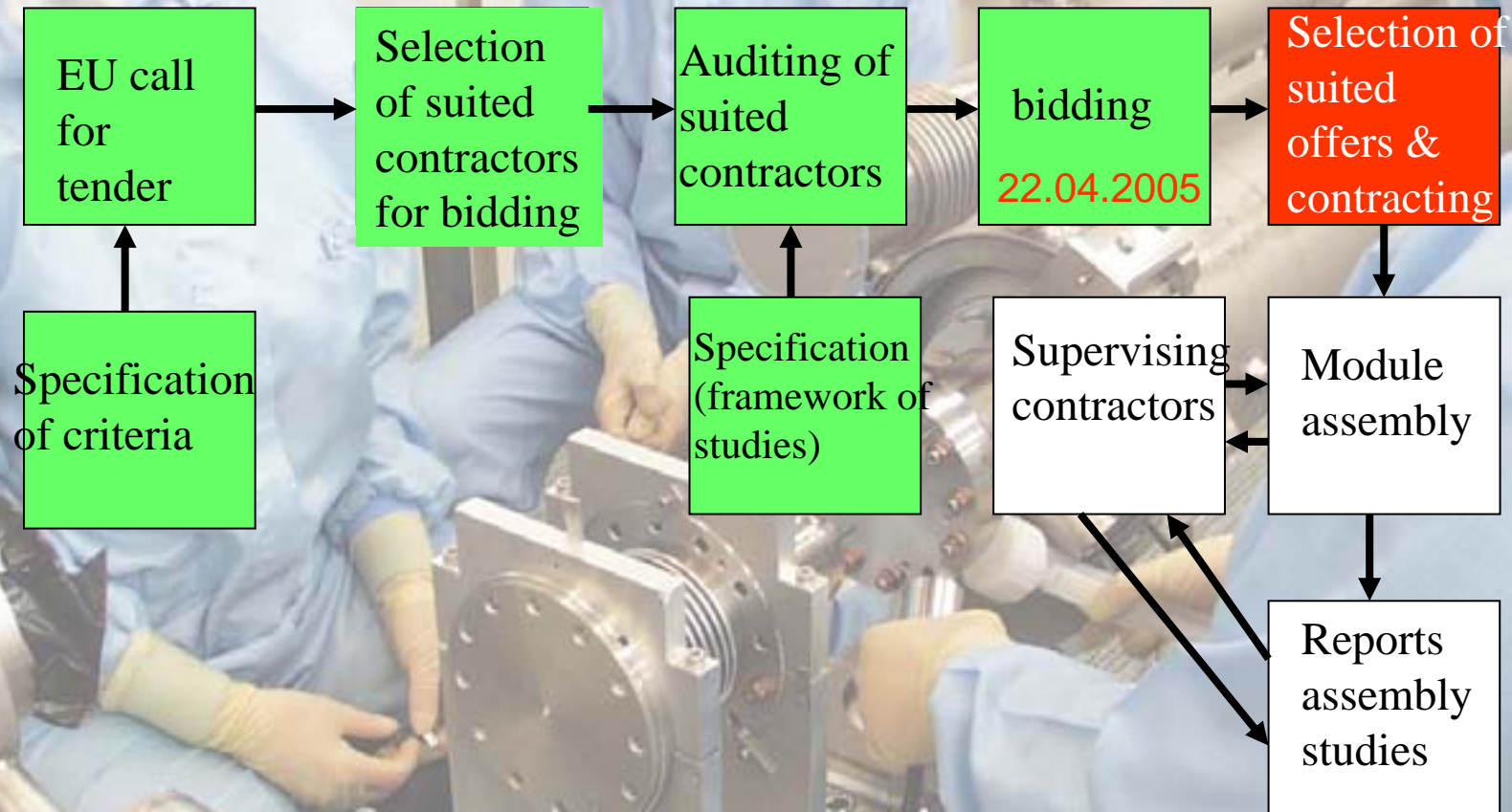
,should have' criteria:

- 4) Experience of applied **Clean-Room Technology** (10-100 ASTM)
- 5) Experience of applied **Ultra-High-Vacuum Techniques** (oil- and particle free).
- 6) General experience in the application of extensive and particular **Low Tolerance Quality Assurance Procedures** in the required fields

Industrial XFEL-cryomodule design and assembly study

Procurement Procedures

21.01.2005



Next Cryomodule Prototypes

production No. (*)	type	required accelerating field	assembly date	comments	material
6	TTF-III	> 35 MV/m	1 / 2006	ACC6 in VUV-FEL	complete
7	TTF-II	20 -25 MV/m	12/ 2005	VUV-FEL spare	complete
8	TTF-III plus	> 28 MV/m	2006	XFEL preparations VUV-FEL spare	to be ordered
9	TTF-III plus	> 28 MV/m	2006	XFEL preparations	to b ordered
10	TTF-III plus-string only	???? MV/m	2006	FNAL	To be ordered
11	XFEL-Prototype	> 28 MV/m	2007	XFEL-prototype	to be ordered

(*) the production number does not necessarily define the order of assembly

Deliverables

Four reports on the specified issues:

- 1) Report on assembly of module 6
- 2) Report on assembly of module 8
- 3) Report on BESSY-FEL cryomodule special issues (cw-operation)
- 4) Final report

These reports will be published as part of the EUROFEL-Study

Cost issues shall be covered in separated attachments to the reports. **These attachments are confidential and will not be published.**