High Precision and Large Mechanical Components

Big Science Business Forum 2020
Session C1 - Machado room
Thursday 6 October 2022

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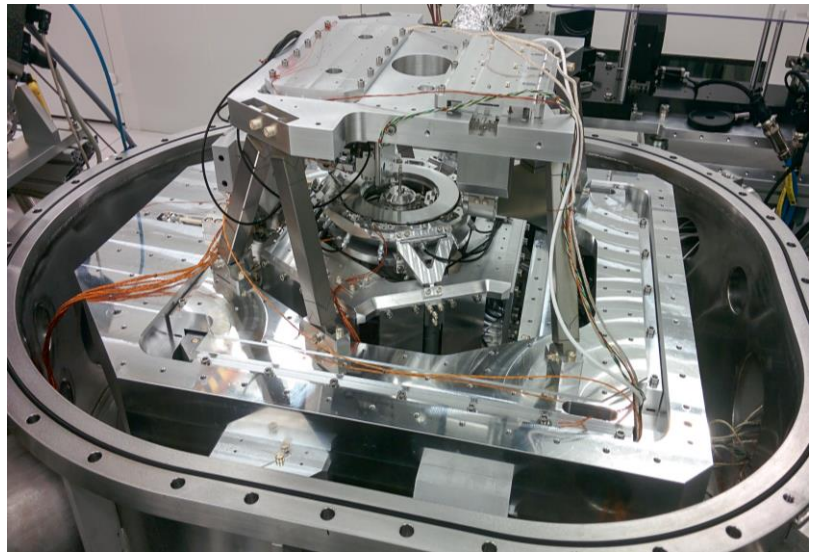
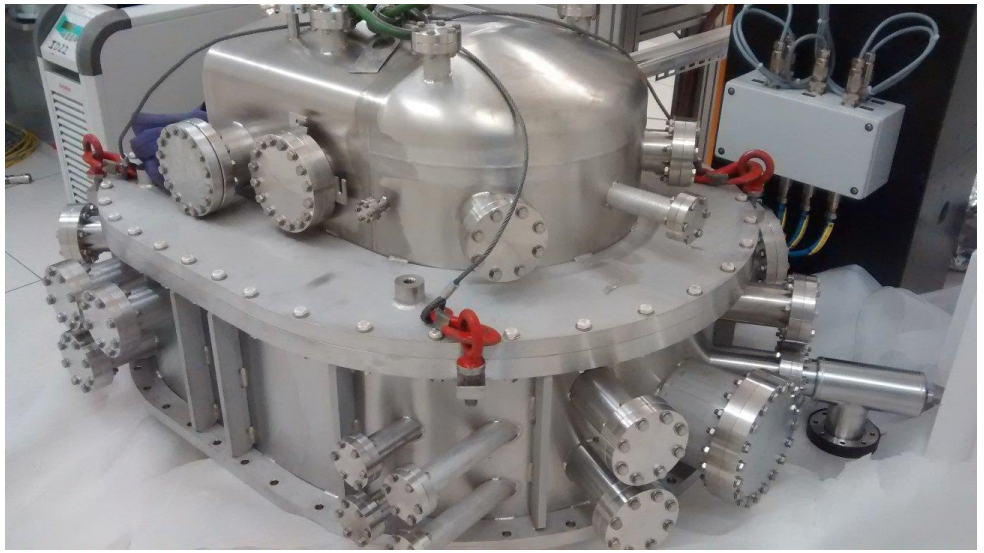
ILO for CERN
Chair Dutch ILO-net

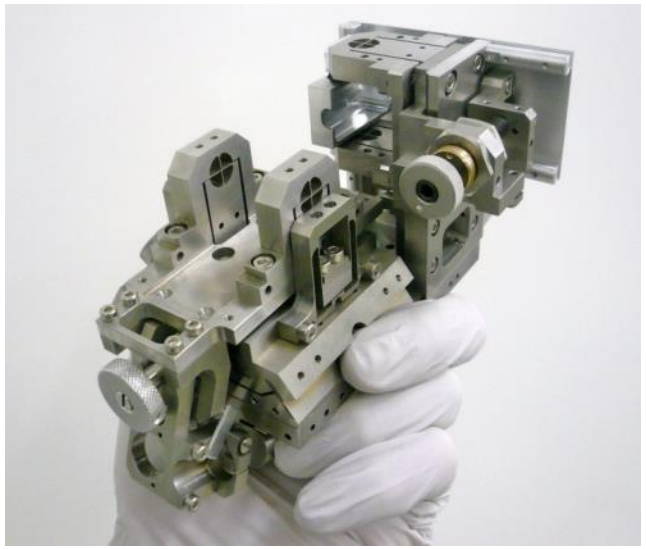
Introduction to the session

- Speakers
  - Olivier Brunner — CERN — Section Leader, Modulators and Klystrons
  - Thomas Rohr — ESA — Head of Materials and Processes Section
  - Juan Carlos Palacio — ESO — Mechanical Engineer
  - Didier Dallé — ESRF — Head of Drafting & Procurement Unit
  - Ulf Odén — ESS — Senior Engineer of Monolith & Handling Group
  - Christina Will — GSI — Head of Mechanical Integration Department
  - Gabriele D'Amico — F4E — Head of Metrology and Reverse Engineering Group
  - David Bazzoli — ILL — Project Manager
  - Rob Anthony — SKAO — Antenna Manufacturing Engineer

Just a flavour







PRESENTATION OF THE ILL

TECHNICAL AREAS OF MANUFACTURING FOR THE REACTOR DIVISION

- NUCLEAR REACTOR = SAFETY AND QUALIFIED PROCUREMENTS

→ General procurement technical rules for reactor parts manufacture

→ What does imply to the supplier ?

- To prove that his workers (and subcontractors) are qualified for the job they have to do (specific quality assurance plan)
- To ensure a perfect tractability of the furniture
- To provide all the required quality documents (Quality plan, welding book, WPS, PQR…)
- To provide all the control documents
- To engage himself to notify the ILL any anomalies noted

Manufacturing of individual parts

- Unitary part only
- Very few series of pieces

- Conventional machining
- Electro-erosion
- Mechanical welded assy
- UHV manufacturing
- Welding
- Brazing
- Inspection report
- *Additive manufacturing*

Manufacturing of comprehensive instrument

- Machining of all parts
- Possibility of pre-assembly

Assembly of instrument

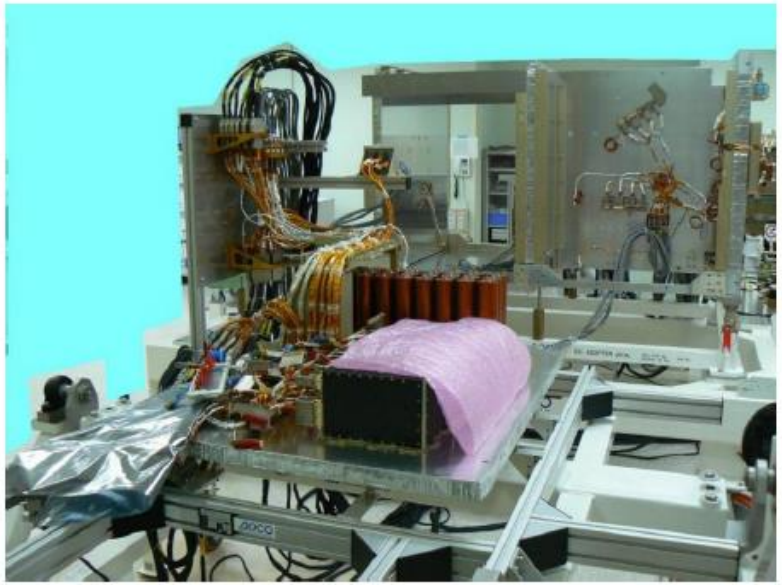
- Machining of all parts
- Purchase of commercial parts
- **Full Assembly**
- Preliminary tests
- Functional tests

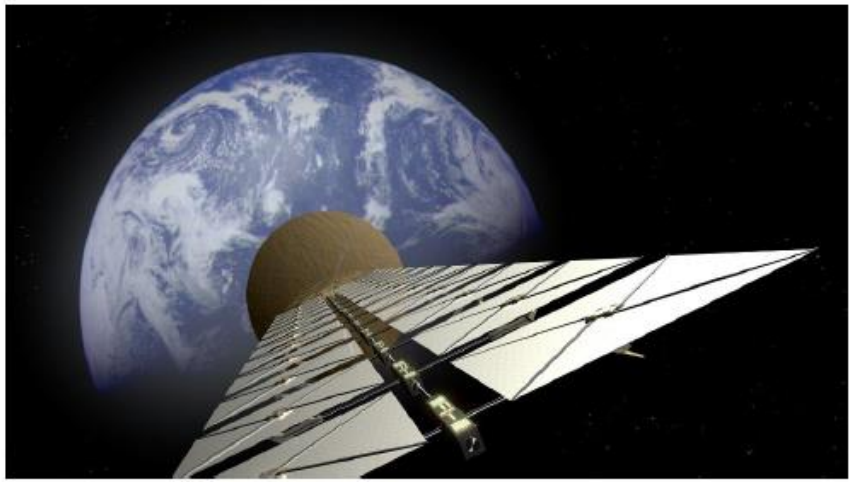
Development and production procedure

Specification	Design		Production	FAT	SAT
	CDR	FDR			
Description of procedure, draft models and drawings of the stands with interfaces and delivery sequence	Check of 3D-model (data hygiene) Check of solution Check of inerfaces Calculations Risk analysis Draft of Manuals Draft of QR plan Draft of production plan	Check of drawings (data hygiene) Check of content manuals QR plan Production plan	Progress reports NCR	Acceptance test measurement protocolls NCRs Documentation	Test installation of selected components

New Paradigm: On-Orbit Manufacturing

- Spacecraft on-orbit refurbishment and upgrade enabled → **life extension**, cost savings compared to launching new assets
- Longer term: leasing of assets (e.g. reflectors), decoupled payload and platform → payload update on orbiting platforms; platforms leasing
- Long term: manufacturing and maintenance of very large structures (e.g. space-based solar power)
- Benefits **applicable to a wide range of missions** for Telecom, Earth Observation, Navigation, Science, Exploration





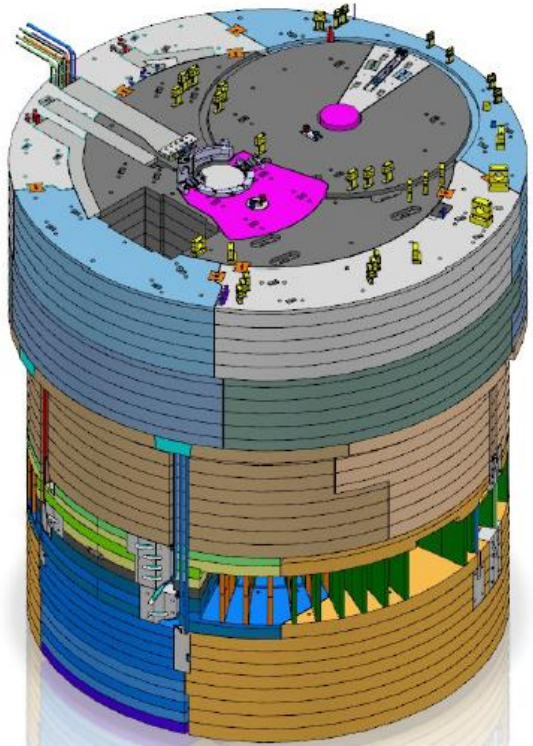
Inner Shielding

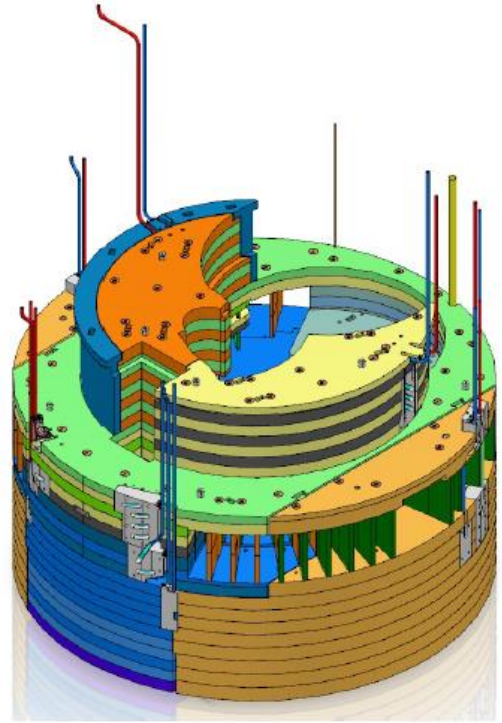
Detecion and repair of a leak

Main Design Requirements:

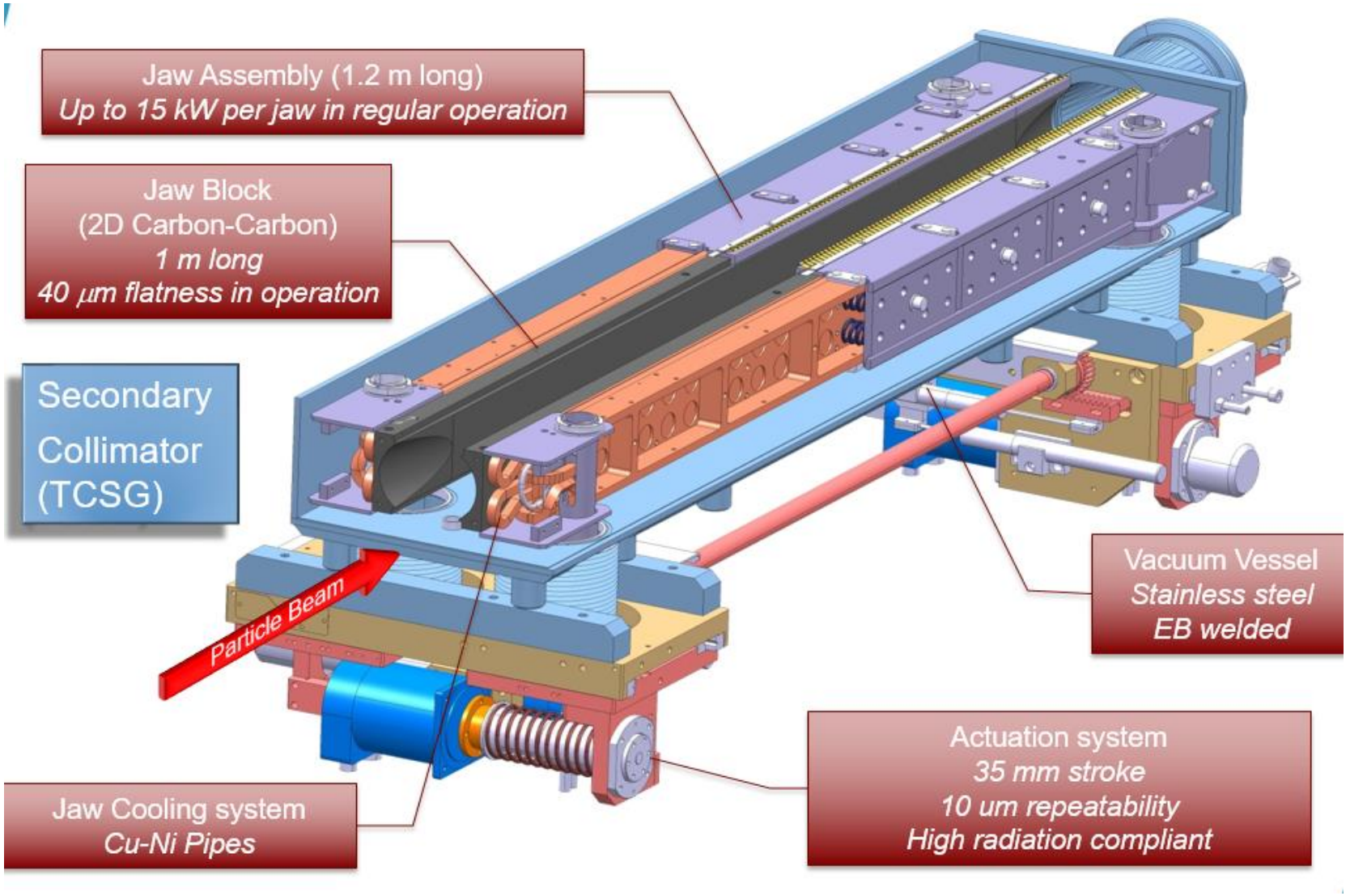
Maximum leakage 1g water/h

Minimum 40 year of operation





LHC collimator challenges



Business Opportunities

FUSION FOR ENERGY

Ion Cyclotron (IC) Resonance Heating

ITER Organization Scope

General Scope

- Procurement of raw materials
- Manufacturing of prototypes and testing activities.
- Final design

Main Technical Challenges

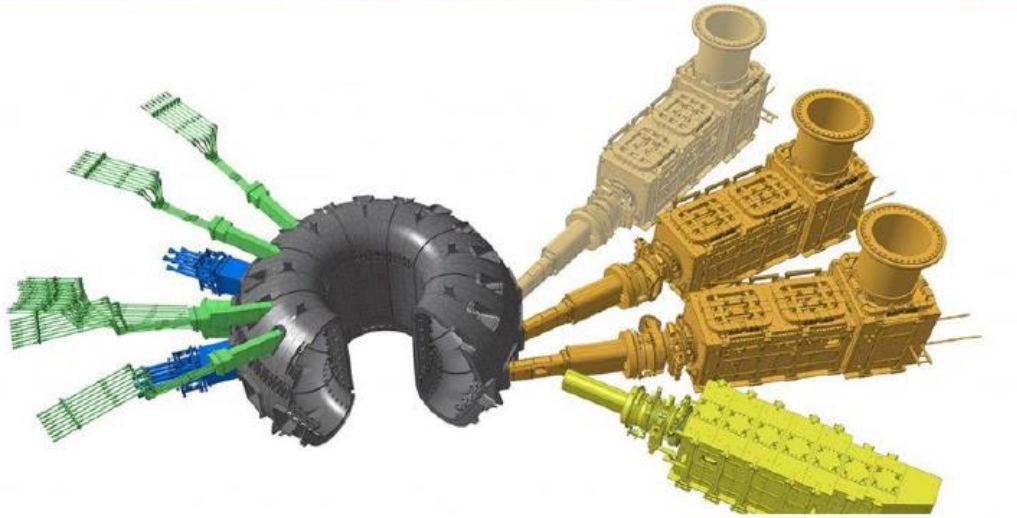
- Materials including CuCrZr, 316L/N/-IG forgings/plates/pipes

Contract Value

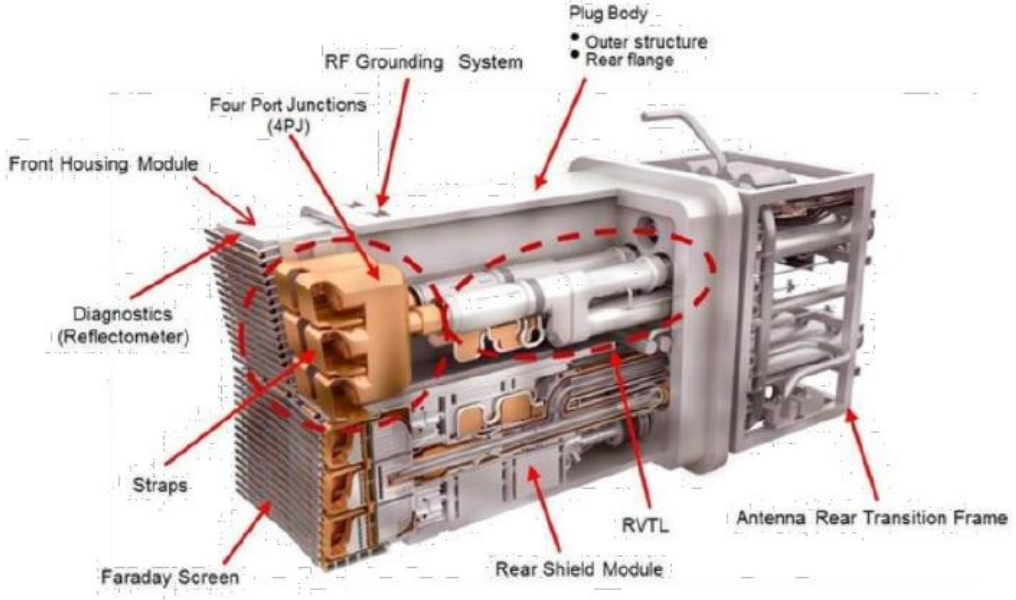
- Ad-hoc

Status/Deadlines

- 2022-2023



ITER external heating: IC (blue), EC (green) and NB (yellow)

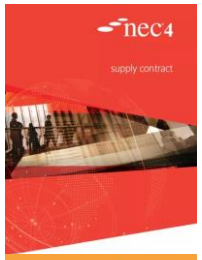


ion cyclotron resonant heating antennas

NEC4 Suite of Contracts

- PSC: Professional Services Contract

- ECC: Engineering and Construction Contract



- SC: Supply Contract

- PSSC Professional Service Contract Short

" The Parties shall act in the spirit of mutual trust and co-operation"

Session format

- Presentations of 10 minutes each
  - Olivier Brunner — CERN — *LHC collimators challenges*
  - Thomas Rohr — ESA — *High Precision and Large Mechanical Components at ESA*
  - Juan Carlos Palacio — ESO — *Precision structures in large ground-based telescopes*
  - Didier Dalle — ESRF — *Overview on mechanical manufacturing at the ESRF*
  - Ulf Odén — ESS — *ESS Target System development and corrective maintenance*
  - Christina Will — GSI — *Physics without supports and assembly?*
  - Gabriele D'Amico — F4E — *The Geometrical Compliance of Mechanical Components: challenges and opportunities*
  - David Bazzoli — ILL — *The needs of the ILL*
  - Rob Anthony — SKAO — *High Precision and Large Mechanical Components at SKA*
- Discussion session