OBJECTIVES OF THIS TALK

• Status of procurements (hints)

• Scope of main future European industrial procurements in the NB and EC Power Supplies and Sources areas

• Future opportunities for Industry
THE ITER HEATING NEUTRAL BEAM (NB) SYSTEM AND THE NB TEST FACILITY

HNB (1 &2) injector full scope of procurement shared with Japan

EU to procure:
- components located floor 0 (picture)
- power supplies (not represented)

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NEUTRAL BEAM TEST FACILITY

Located in Padua (Italy) – Host Consorzio-RFX providing Buildings and Infrastructures
F4E, Japan DA and India DA providing all components and auxiliaries under PAs with IO

SPIDER (Source for Production of Ion of Deuterium Extracted from Radio frequency plasma)

MITICA (Megavolt ITer Injector & Concept Advancement)

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**NBTF- Recent Pictures**

**SPIDER Bio-shield and Vacuum Vessel**

- SPIDER Vacuum Vessel installed inside the Bio-shield
- 100 kV High Voltage bushing installed on VV
- NBTF Cooling System (70 MW) secondary heat transfer system pumps

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**NBTF- Recent Pictures**

**SPIDER Ion Source Power Supplies and HV Deck**

- SPIDER HV Deck
- SPIDER Transmission Line under Assembly
- SPIDER Ion Source Power Supplies installed inside HV Deck

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List of main NBTF Calls for Tender to be launched by F4E (delivery NBTF, Padua)

<table>
<thead>
<tr>
<th>Component</th>
<th>CfT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 MITICA SF6 Plant</td>
<td>CFT closed</td>
</tr>
<tr>
<td></td>
<td>Bids under evaluation</td>
</tr>
<tr>
<td>2 MITICA Beam Source</td>
<td>CfT on-going</td>
</tr>
<tr>
<td></td>
<td>Deadline 4.3.2016</td>
</tr>
<tr>
<td>3 MITICA Beam Line Components (Neutralizer, Calorimeter, RID)</td>
<td>2016 (Q4)</td>
</tr>
<tr>
<td>4 MITICA Cryopump</td>
<td>See A Teissier’s this Forum</td>
</tr>
<tr>
<td>5 MITICA Cryogenic Plant</td>
<td>See A Teissier’s this Forum</td>
</tr>
</tbody>
</table>

MITICA BEAM LINE COMPONENTS (BLCS)

- Actively cooled - 2.4 MPa water pressure
- Water cooled OFHC copper (Max power density≈ 0.5 MW/m²). Water Cooled Panels or tubes in CuCrZr (Power density > to 1MW/m²)
- Structure and piping manifold made out of AISI 316 L. Numerous heterogeneous joints are present
- Welding techniques needed. Electron Beam (EB) Welding foreseen
- Deep drilling technology for the walls of NED and RID
- Vacuum expertise necessary. Assembly and metrology (alignment) competencies required

Calorimeter 14MW/m² - 18MW - 7 tons
Electrostatic Residual Ions Dump (RID) 6MW/m² - 19MW - 5 tons
Neutraliser (NED) - (0.5 MW/m² to 3MW/m² leading edges) 5.5MW - 15 tons
List of main HNB contracts for ITER to be launched by F4E (delivery Cadarache)

<table>
<thead>
<tr>
<th>Component</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Beam Sources (included in FWC presently under CfT)</td>
<td></td>
</tr>
<tr>
<td>2. Beam Line Components (Neutralizer, Calorimeter, RID)</td>
<td></td>
</tr>
<tr>
<td>3. 4 lots: Vessel (Beam Line + Beam Source), Drift Duct, Exit Scraper, Fast Shutter- All except Exit Scraper are SIC-1 (RCC-MR code)</td>
<td></td>
</tr>
<tr>
<td>4. Absolute Valve - SIC-1 (RCC-MR code)</td>
<td></td>
</tr>
<tr>
<td>5. ACC-Coils</td>
<td></td>
</tr>
<tr>
<td>6. Passive Magnetic Shielding</td>
<td></td>
</tr>
<tr>
<td>7. Assembly of HNB1 &amp; HNB2</td>
<td></td>
</tr>
</tbody>
</table>

CfT aligned to ITER 2016 scheduling underway

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**ITER HNB components**

**The NBI Vessel**

An extension of the primary vacuum confinement and of the primary safety barrier – SIC1 (RCC-MR code)

2 x 2 Stainless-Steel Tanks (Beam Line Vessel and Source Vessel) - (5 x 5 x 15 m²)

**Weight:** BLV → about 40 tons - BSV → about 30 tons
**ITER HNB components**

**Passive Magnetic Shield (PMS)**

With Active Magnetic Field, reduction of almost three orders of magnitude of the external Magnetic field to ensure a good beam transmission.

PMS: Steel (S235) Plates 75mm thick all around the vessels - To reduce the activation dose in NB cell, the interspace between the layers of the PMS will be filled-in with polyethylene (10cm) and its external face with lead (between 1 and 2.5 cm). Total weight = 700 tons (each injector)

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**ITER HNB components**

**Active Compensation Correction-Coils ACC-Coils)**

Acting together with PMS, reduction of almost three orders of magnitude of the external Magnetic field to ensure a good beam transmission.

ACC-Coils: 2 x 6 Coils – Water Cooled Conductor in OFHC - Dimension about 3,3m x 3m - 92000 kA-turns to 200000 kA-turns – Coil Cross-section typically 400x200 mm² - Coils Weight = 9 and 18 Tons)

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Electron Cyclotron (EC) System
The EU gyrotron development programme

Development programme carried out in collaboration with EGYC Consortium of EU Labs and Thales
Full design verification planned in 2016

- 1MW CW 170 GHz industrial prototype gyrotron (based on successful results from a short-pulse tube): delivered in Nov-15, current under conditioning at the KIT (Karlsruhe) gyrotron test stand

- Cryogen-free Superconductive Magnet for the CW gyrotron prototype (6.87 T at the cavity): Contract signed in 2015 → delivery planned in Autumn-16
### EC PS&S Contracts Summary

**List of main EC Power Supplies and Sources Calls for Tender to be launched by F4E**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Series production of Gyrotron tubes - (expected procedure: negotiated)</td>
</tr>
<tr>
<td>2</td>
<td>Series production of gyrotron superconducting magnets (cryogen-free)</td>
</tr>
<tr>
<td>3</td>
<td>Auxiliaries for the RF Sources (cooling manifold, supporting structures, control-command, etc.)</td>
</tr>
</tbody>
</table>

CfT aligned to ITER 2016 scheduling underway
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