EU Procurement of In-Vessel Components for ITER

State of progress and next steps

Patrick Lorenzetto

EU In-Vessel Procurement Packages

- Blanket First Wall Procurement Package
  See presentation from Jean-Marc Filhol.

- Blanket Cooling Manifold Procurement Package

- Divertor Cassette Body Procurement Package
  See presentation from Jean-Marc Filhol.

- Installation of Divertor Cassette Plasma Facing Components

- Divertor Inner Vertical Target Procurement Package
  See presentation from Jean-Marc Filhol.

- Divertor Rails Procurement Package
  > 2020.
Blanket Cooling Manifold
Procurement Package

Outboard system (OB) = 12-pipes bundles
Inboard system (IB) = 8-pipes bundles

Task 1: Chimney Pipes
Task 2: 6 Sectors IB+OB
Task 3: 3 Sectors IB+OB

Task 4: Lower Port Pipes feeding NBI modules
Task 5: Upper Port Pipes
Task 6: Branch pipes + Coaxial Connectors (ITER Assembly Phase 2)
Blanket Cooling Manifold Design (2/3)

- The BCM provides cooling water to the Blanket System. It contributes to the nuclear and thermal shielding.
- Seamless pipes (OD = 48.3, 60.3, 70 x 2.7 mm), cold bent. (+/- 6.5 km of pipes)
- Remote Handling Class 3. Number of field welds to be minimized.
- Theoretical feasibility study performed for the Concept Design Review.

Outboard Bundle with supports and shielding blocks

Blanket Cooling Manifold Design (3/3)

- Coaxial Connectors + branch pipes customized after laser survey (Part of Task 6 - Installation is being validated by means of full scale prototypes)
- Typical Inboard Support Clamp-shells brazed onto pipes - Part of Tasks 2 & 3
- Coaxial Connector made from 316L stainless steel (Part of Task 6)
- Supports will be electrically isolated (to reduce EM loads) and brazed (to maximize heat conduction)
- Typical Outboard Support (Clamp-shells brazed onto pipes - Part of Tasks 2 & 3)

A partial full-scale prototype of a Blanket Cooling Manifold pipe bundle was successfully manufactured by Dockweiler GmbH. Lessons learned incorporated in the Blanket Cooling Manifold design. Separate prototype will be manufactured to prove the feasibility of the brazed support design.

Skills and competencies expected from the tenderers:

- Cold bending of pipes of relevant dimensions;
- Accurate shaping of pipe profile (e.g. ± 1.5mm at critical locations);
- Fast and accurate laser survey methods during production;
- Stress annealing by heat treatments;
- Pipe Welding (TIG) with and without filler material;
- Non-Destructive Examination (visual inspection, X-ray, ultrasonic testing);
- Application of ceramic/alumina coating on Stainless Steel (SS) as electrical isolation;
- Brazing of CuCrZr on ceramic/alumina and CuCrZr on SS.
Blanket Cooling Manifold
Summary of next calls for tender

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<tr>
<th>Systems</th>
<th>Planned activities</th>
<th>Date</th>
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<tbody>
<tr>
<td>Blanket Cooling Manifold</td>
<td>Information day at F4E Barcelona</td>
<td>TBD</td>
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<tr>
<td>Blanket Cooling Manifold</td>
<td>Call for Tender 1 (Tasks 1 to 3)</td>
<td>TBD</td>
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<tr>
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<td>Call for Tender 2 (Tasks 4, 5)</td>
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➢ TBD dates: To Be Defined after approval by the ITER Council of the on-going 2016 ITER scheduling.

➢ Contact persons at F4E’s Market Intelligence Group:
  Mehdi Daval: +34 93 489 7454, mehdi.daval@f4e.europa.eu

Divertor Cassette Assembly
Installation of Divertor Cassette Plasma Facing Components
### Divertor Cassette Assembly

**Design**

- Inner Vertical Target (IVT)
- Outer Vertical Target (OVT)
- Dome (DO)
- Standard Cassette Body (CB)

- Cassette Assembly ~ 7.9 tons
- Cassette Body ~ 4.7 tons

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### Divertor Cassette Assembly

**Procurement Arrangement - scope of supply**

**17.P1 “Divertor Cassette Integration”**

- **Manufacturing of:**
  - 1 full-scale prototype (qualification)
  - 54 cassettes
  - 4 spare cassettes
- Installation of the Plasma Facing Components (PFCs);
- Installation of the diagnostics and instrumentation equipments.

Procurement Arrangement signed on 08.05.2012.

**17.P2-B “Divertor Plasma-Facing Components – Inner Vertical Target**

- **Manufacturing of:**
  - 1 full-scale prototype (CFC-W) for the pre-production qualification
  - 1 full-scale prototype (full-W) for the pre-production qualification
  - 54 Inner Vertical Targets (IVT)
  - 6 spare IVTs

Procurement Arrangement signed on 12.03.2010.
Divertor Cassette Assembly
Installation of Plasma Facing Components

Divertor Cassette Assembly
Installation of Diagnostics

20 Divertor Cassettes with Diagnostic and instrumentation, e.g.:

- Neutron flux monitor;
- Impurity monitor;
- Optical box
- Dust monitor;
- Rogowski coils;
- Pick-up, orthogonal coils;
- Langmuir probes
- Loom of cables and RH electrical connector,
- Pressures gauges
- Thermocouples
- Linear Displacement sensors...
Main operations of the Plasma Facing Component (PFC) installation work:

- Design & procurement of welding and inspection tools;
- Jigs and fixtures for the assembly of the PFCs onto the Cassette Bodies (CB);
- The qualification of the assembly procedures by means of the full-scale PFCs and CB prototypes;
- Acceptance tests of the Divertor cassette assembly as follows:
  a. Cold water flow test
  b. Hydraulic Pressure test
  c. Cold He leak test
  d. Dimensional control

Divertor Cassette Assembly
R&D programme

Full scale dummy prototype manufacturing and testing

Achievements (2005):

- Verification of the hydraulic design of the divertor.
- Verification of assembly and integration procedures on a full-scale prototype with realistic tolerances, dimensions, weight and accessibility.
**Divertor Cassette Assembly**

**Main skills and experience required**

Technical experience in:

- Assembly of High Vacuum components (for pressure equal to or less than $10^{-2}$ Pa);
- Welding, inspection and welding qualification of austenitic stainless steels materials in accordance with standards;
- Precise machining (e.g. interfaces adjustment);
- Helium leak testing (leak rate equal to or less than $1.10^{-7} \text{ Pa.m}^3\text{s}^{-1}$) of components with dimensions equal or greater than 2 m x 0.5 m x 0.5 m;
- Hydraulic flow and pressure testing (equal or greater than 50 bars);
- Dimensional inspection and precise handling (survey of components of 2 m x 1 m x 0.5 m with tolerances equal or less than 0.1 mm).

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**Divertor Cassette Assembly**

**Summary of next calls for tender**

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<td>Information day to allow exchange of information with possible bidders prior to the Call-for-Tenders.</td>
<td>TBD</td>
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<tr>
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<td>Call-for-Tender for the installation of PFCs on the Cassette Bodies.</td>
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