EU Procurement of In-Vessel Components for ITER

State of progress and next steps

Patrick Lorenzetto
Content

- Introduction
- Blanket Cooling Manifold Procurement Package
- Divertor Cassette Body & Installation of Plasma Facing Components Procurement Package
EU In-Vessel Procurement Packages

- **Blanket First Wall Procurement Package**
  
  See presentations from:
  
  - AREVA NP;
  
  - IBERDROLA, AMEC & MIB Consortium;
  
  - ATMOSTAT/ALCEN group.

- **Blanket Cooling Manifold Procurement Package**

- **Divertor Cassette Body & Installation of Plasma Facing Components Procurement Package**

- **Divertor Inner Vertical Target Procurement Package**
  
  See presentation from ANSALDO Nucleare.

- **Divertor Rails**
  
  > 2017.
Blanket Cooling Manifold

Procurement Package
Task 1: Chimney Pipes

Task 2: 6 Sectors IB+OB
Task 3: 3 Sectors IB+OB

Task 5: Upper Port Pipes

Task 4: Lower Port Pipes feeding NBI modules

Task 6: Branch pipes + Coaxial Connectors (ITER Assembly Phase 2)

Inboard system (IB) = 8-pipes bundles

Outboard system (OB) = 12-pipes bundles

IBF/15, Marseille, 25-27 March 2015
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.
- Remote Handling Class 3. Number of field welds to be minimized.
- Theoretical feasibility study performed for the Concept Des Review.
Coaxial Connectors + branch pipes customized after Laser Survey (Task 6)

Typical Inboard Support (part of Tasks 2 & 3)

Supports will be electrically isolated (to reduce EM loads) and brazed (to maximize heat conduction)

Coaxial Connector made from 316L stainless steel (part of Task 6)

Typical Outboard Support (part of Tasks 2 & 3)
Partial full scale prototype (5 pipes)

- A partial full-scale prototype of a blanket cooling manifold (BCM) pipe bundle was successfully manufactured by Dockweiler GmbH.
- Lessons learned being incorporated in the BCM design.
- Separate prototype will be manufactured to prove the feasibility of the brazed support design.
Blanket Cooling Manifold
Procurement package

<table>
<thead>
<tr>
<th>1.5 BCM system</th>
<th>Component</th>
<th>Credit (kIUA)</th>
<th>Sharing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procurement Arrangement 1.5.P1A.EU.02</td>
<td>Blanket Cooling Manifold</td>
<td>4.522</td>
<td>EU = 100 %</td>
</tr>
</tbody>
</table>

The Blanket Cooling Manifold procurement is “build to print”.

Key dates

- Final Design Review (Dec. 2015 – To Be Confirmed (TBC));
- Procurement Arrangement (May 2016 – TBC);
- Information Day at F4E in June 2016;
- **Call for tender for Tasks 1-5: Q4-2016**;
- Deliverables on sites: 2022-2023 (Assembly Phase 1) - TBC.
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
Tentative design and procurement roadmap


- Conceptual design
  - CDR – 28/09/2011

- Design Phase
  - Structural Analyses and Finalization of the Design
  - Contract for Partial Prototype 20/06/2013
  - Partial Prototype Manufacturing
  - FDR – Dec 2015
  - Approval of FDR – 28 Feb 2016

- Prototype Fabrication
  - 30 Jul 2014 Completion of prototype manufacturing
  - Qualification of Support Design (by IO)

- Tendering period
  - Preparation of PA Documentation
  - PA signature - 30 May 2016

- Production period
  - BCM Information Day - June 2016

Task 1: Chimney Pipes
Task 2: Pipe bundles for 6 Sectors
Task 3: Pipe bundles for 3 Sectors
Task 4: Lower port pipes
Task 5: Upper port pipes

- Series production
  - Call for Tender 1 – Tasks 1 - 5
  - Contracts Signature – Dec 2017
  - Tasks 1-3
  - Tasks 4-5

IBF/15, Marseille, 25-27 March 2015
## Blanket Cooling Manifold

### Summary of next calls for tender

<table>
<thead>
<tr>
<th>Systems</th>
<th>Planned activities</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blanket Cooling Manifold</td>
<td>Information day at F4E Barcelona</td>
<td>June 2016</td>
</tr>
<tr>
<td>Blanket Cooling Manifold</td>
<td>Call for Tender 1 (Tasks 1 to 5)</td>
<td>Q4-2016</td>
</tr>
<tr>
<td>Blanket Cooling Manifold</td>
<td>Call for Tender 2 (Task 6)</td>
<td>(Assembly Phase 2)</td>
</tr>
</tbody>
</table>

- Contact person at F4E for detailed information:
  - Georges Dellopoulos
  - +34 93 489 7526
  - Georges.Dellopoulos@f4e.europa.eu
Divertor Cassette Body and Installation of Plasma Facing Components Procurement Package
**Divertor Cassette Body & Installation 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**

IBF/15, Marseille, 25-27 March 2015
17.P1 “Divertor Cassette Integration”

- Manufacturing of:
  - 1 full-scale prototype (qualification)
  - 54 cassettes
  - 6 spare cassettes
- Installation of the Plasma Facing Components (PFCs);
- Installation of the diagnostics 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

VERTICAL TARGET
INNER AND OUTER

PIPE STUBS

KNUCKLE

DOME

NOSE

CASSETTE BODY (CB)
STEEL STRUCTURE
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
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.

ANSALDO (Manufacture) & ENEA (Installation)
Technical experience in:

1. Assembly of High Vacuum components (for pressure equal to or less than $10^{-2}$ Pa);
2. Welding, inspection and welding qualification of austenitic stainless steels materials in accordance with standards;
3. Precise machining (e.g. interfaces adjustment);
4. Helium leak testing (leak rate equal to or less than $1.10^{-7}$ Pa.m$^3$.s$^{-1}$) of components with dimensions equal or greater than 2 m x 0.5 m x 0.5 m;
5. Hydraulic flow and pressure testing (equal or greater than 50 bars);
6. 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).
**Divertor Cassette Assemblies**

**Tentative procurement roadmap**

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<tbody>
<tr>
<td>Signature PA</td>
<td>Preparation for Cassette Body prototype &amp; series CfT</td>
<td>Cassette Body Prototype</td>
<td>&lt;IPL Requirements Diagnostics &amp; DOI</td>
<td>Market survey</td>
<td>Information day at Barcelona</td>
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<tr>
<td>Cassette Body Prototype</td>
<td>CfT &amp; award for Cassette Body prototype &amp; series</td>
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<td>Cassette Assembly Prototype</td>
<td>&lt; IPL Final documentation for diagnostics</td>
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<td>Cassette Assembly Series production</td>
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- **CfT phase (including Award of contract)**
- **Release of contractual option**
- **Cassette Body (CB) Manufacturing**
- **Cassette Assembly (CA) Integration**

**Tentative procurement roadmap**:
- IBF/15, Marseille, 25-27 March 2015
### Divertor Cassette Assemblies

#### Summary of next calls for tender

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<th>Call</th>
</tr>
</thead>
<tbody>
<tr>
<td>Divertor Cassette Assemblies</td>
<td>A market survey planned to provide F4E with preliminary information on possible candidates.</td>
<td>Q2-2015</td>
</tr>
<tr>
<td>Divertor Cassette Assemblies</td>
<td>An information day planned to allow exchange of information with possible bidders prior to the Call-for-Tenders.</td>
<td>Q3-2015</td>
</tr>
<tr>
<td>Divertor Cassette Assemblies</td>
<td>A Call-for-Tenders planned for the installation of PFCs for the Cassette Assemblies.</td>
<td>Q1-2016</td>
</tr>
</tbody>
</table>

- Contact persons at F4E for detailed information:
  - Laurent Guerrini / Bruno Riccardi: +34 93 320 1846 / 93 489 7484
  - Laurent.Guerrini@f4e.europa.eu / Bruno.Riccardi@f4e.europa.eu
Thank you for your attention

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