EU Contribution to ITER Fuel Cycle

Update on technical and procurement status

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Fusion for Energy

Outline

For each type of Fuel Cycle components to be procured by F4E, we will present an overview of:

• The equipment.
• The duties to be fulfilled by the equipment.
• The procurement plan.
• The experience required for supplying the equipment.
• The procurement schedule.
Fuel Cycle components to be procured by F4E:

• Vacuum Pumping.

• Tritium Plant.

• Radiological and Environmental Monitoring Systems.

• Waste Management Systems.

Vacuum pumping

• Equipment:
  – Cryopumps = vacuum pumps which trap gases and vapours on a cold surface.
  – Cold valve boxes and cryolines.
  – Leak detection and localisation components.

• Duties:
  – To provide the ITER tokamak with clean, ultra high vacuum at large pumping speed.
  – To distribute helium to and from the cryopumps.
  – To detect and locate leaks.

• Procurement plan:
  – Contracts for design.
  – Contracts for manufacturing (including final design as regard the cold valve boxes and cryolines).

• Experience required:
  – For design: vacuum, cryogenics.
  – For manufacturing: welding and machining, helium leak detection, metrology, cleanliness, coating, pressure equipment.
**Vacuum pumping**

**Cryopumps**

<table>
<thead>
<tr>
<th>Scope</th>
<th>Timescale - Call to be launched in:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cryopump design</td>
<td>√ (done)</td>
</tr>
<tr>
<td>Pre-production cryopump</td>
<td>√</td>
</tr>
<tr>
<td>MITICA cryopump</td>
<td>End 2013</td>
</tr>
<tr>
<td>Torus and cryostat cryopumps (x 8)</td>
<td>Mid 2014</td>
</tr>
<tr>
<td>Neutral Beam cryopumps (X 4)</td>
<td>2015</td>
</tr>
</tbody>
</table>

ITER neutral beam cryopump
- For evacuation of beam line vessel
- Very low pressure ($10^{-7}$ Pa)

**Cold valve boxes, cryolines, leak detection and localization components**

<table>
<thead>
<tr>
<th>Scope</th>
<th>Timescale - Call to be launched in:</th>
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</thead>
<tbody>
<tr>
<td>Cold valve boxes and cryolines preliminary design</td>
<td>√</td>
</tr>
<tr>
<td>Warm regeneration lines (for cryopump regeneration) procurement</td>
<td>Mid 2013</td>
</tr>
<tr>
<td>Cold valve boxes (X12) and auxiliaries procurement</td>
<td>Early 2014</td>
</tr>
<tr>
<td>Leak detection and localization procurement</td>
<td>2014</td>
</tr>
</tbody>
</table>
Tritium plant

- **Equipment:**
  - Water detritiation system.
  - Isotope separation system.

- **Duties:**
  - To detritiate water.
  - To produce pure deuterium as well as 90% tritium/10% deuterium mixture.

- **Procurement plan:**
  - Contracts for conceptual design.
  - Contracts for preliminary design.
  - Contracts for final design and manufacturing.

- **Competences required:**
  - Chemical component separation (cryogenic distillation, catalysts).
  - Experience in handling of tritiated gases, large component manufacturing.
Water detritiation system (WDS)

Detritiation of water (20 kg/h @ 10 Ci/kg) by CECE (Combined Electrolysis Catalytic Exchange) method:
- cracking water into hydrogen and oxygen,
- stripping the residual tritium from the hydrogen before its release.

Scope | Timescale - Call to be launched in:
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WDS conceptual and preliminary designs | ✓
WDS tanks (2 x 100 m³ and 4 x 20 m³) procurement | April 2013
WDS “Main” procurement | 2015

100 m³ WDS tanks (x 2)
- Stainless steel type 304L,
- ASME B&PV VIII (ASME III for seismic analysis),
- Not classified as pressure equipment.
**Tritium plant**

**Isotope separation system (ISS)**

<table>
<thead>
<tr>
<th>Scope</th>
<th>Timescale - Call to be launched in:</th>
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</thead>
<tbody>
<tr>
<td>ISS conceptual design</td>
<td>✓</td>
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<tr>
<td>ISS preliminary design</td>
<td>Mid 2015</td>
</tr>
<tr>
<td>ISS procurement</td>
<td>End 2016</td>
</tr>
</tbody>
</table>

**Radiological and Environmental Monitoring Systems**

- **Equipment:**
  - Radiological detectors and process systems.
  - Personnel control and environmental monitoring systems.

- **Duties:**
  - To monitor radiations and particles (room, process, personnel).
  - To monitor environment.

- **Procurement plan:**
  - Many components are off-the-shelf items but need to be adapted to ITER requirements.
  - Procurement split into three phases: preliminary design; final design; manufacturing, on-site installation and tests.

- **Competences required:**
  - Sensors and detectors for nuclear use.
  - Experience in radiological and environmental safety.
  - System integration (electronics, software).
REM preliminary equipment list

**HP laboratory**
- Atomic Absorption
- Spectrophotometers (2)
- Smear test counter (3)
- Microwave digesters (2)
- Glove boxes (7)
- Gamma spectrometers (4)
- Liquid scintillation counters (5)
- Total gamma detectors (4)
- Alpha/beta counters (1)
- Laboratory Plant Control System

**Area Be Monitoring System (ABMS)**
- Be Samplers (50)

**Process Control**
- Tritium detectors HVAC/DS (201)
- Tritium detector port cell (10)
- Logic module 2/3 (67)

**Individual Monitoring System (IMS)**
- Dosimeters Integrator [B/γ] (1600)
- Electronic dosimeters (750)
- Dosimeters readers (10)
- Dosimeter Plant Control System
- Personal Be samplers (50)
- Personal Gas monitors (50)
- Portable X-rays monitors (5)
- Be particulate in air samplers (5)
- Portable T in air samplers (2)
- Portable aqueous samplers (20)
- Portable Ra monitors (2)
- Portable gamma monitors (17)
- α/β particulate samplers (2)
- Portable β/γ surface cont. monitors (12)
- Portable neutron monitors (7)
- Whole body counters (2)
- Breathing air analyzer (2)
- Tools monitors (2) and Portal monitors (2)
- Friskers (35) and Floor Monitors (2)
- Particulate samplers (25)
- Portable T samplers (18)
- Portable C-14 sampler (5)
- Mobile gamma monitors (30)
- Mobile gas monitors (4)
- Mobile β/γ monitors (25)
- Mobile T monitors (50)
- Contamination checking at fence (1)
- Dosimeter Plant Control System

**Area Radiological Monitoring System (ARMS)**
- Gamma monitors (151)
- Neutron monitors (15)
- Tritium monitors (83) and gas monitors (7)
- Particulate monitors (7)
- HT/HTO discrimination samplers (60)
- Particulate samplers (43)
- C-14 sample (1)
- ARMS Plant Control System

**Release Monitoring System (RMS)**
- Gamma monitor (1)
- Tritium monitors (4) and gas monitors (4)
- Particulate samplers & monitors (4)
- HT/HTO discrimination samplers (2)
- Be particulate samplers (2)
- α/β particulate sampler (1)
- C-14 samplers (2)
- Flow rate meters (6)

**Environmental Monitoring System (EMS)**
- Dosimeter Integrator (150)
- Be particulate samplers (8)
- NOx gas analyzers (5)
- Gamma monitors (9)
- HT/HTO discrimination samplers (11)
- C-14 samplers (1)
- Particulate samplers (8)
- EMS Plant Control System
Radiological and Environmental Monitoring Systems

<table>
<thead>
<tr>
<th>Scope</th>
<th>Timescale - Call to be launched in:</th>
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</thead>
<tbody>
<tr>
<td>REMS conceptual design</td>
<td>✓</td>
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<tr>
<td>REMS preliminary design</td>
<td>Mid 2013 (task order from an existing framework contract)</td>
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<tr>
<td>REMS final design</td>
<td>Mid 2014 (task order from an existing framework contract)</td>
</tr>
<tr>
<td>REMS procurement</td>
<td>2016</td>
</tr>
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</table>

Waste Management Systems

- **Equipment:**
  - Radioactive liquid treatment and storage systems.
  - Solid waste characterization equipment, waste processing and storage.

- **Duty:** To process Type-A Rad and conventional waste.

- **Procurement plan:**
  - Mostly industrial items to be adapted to ITER requirements.
  - Procurement split into three phases: preliminary design; final design; manufacturing, on-site installation and tests.

- **Competences required:** radioactive and activated waste management.
Waste Management Systems

**Type-A WMS pre-conceptual design**

<table>
<thead>
<tr>
<th>Radioactive Liquid</th>
<th>Waste Tank</th>
<th>12 m³ each</th>
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</thead>
<tbody>
<tr>
<td>Oil from pumps &amp; machine</td>
<td>Waste Tank</td>
<td>12 m³ each</td>
</tr>
<tr>
<td>Pre-filter</td>
<td>Heating</td>
<td>Filtration</td>
</tr>
<tr>
<td>Oil storage tank</td>
<td>Oil sludge 0.3 m³/y</td>
<td>Low activity oil to export (1.5 m³/y)</td>
</tr>
<tr>
<td>Dewatering system</td>
<td></td>
<td>Onsite temporary storage</td>
</tr>
<tr>
<td>Spent resins 14 m³/y</td>
<td></td>
<td>French temporary or final repository</td>
</tr>
<tr>
<td>Spent resins storage tank</td>
<td></td>
<td></td>
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<tr>
<td>Solid Radiwaste 150 m³/y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X-ray</td>
<td>Sorting &amp; segregation</td>
<td>Band saw cutting</td>
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<tr>
<td></td>
<td></td>
<td>Compactor super-compactor (20T)</td>
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**Scope Timescale - Call to be launched in:**

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<td>WMS final design</td>
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<tr>
<td>WMS procurement</td>
<td>2018 - 2019</td>
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For further information please contact us at
industryportal-info@f4e.europa.eu
mentioning “Fuel Cycle” in subject of your email

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