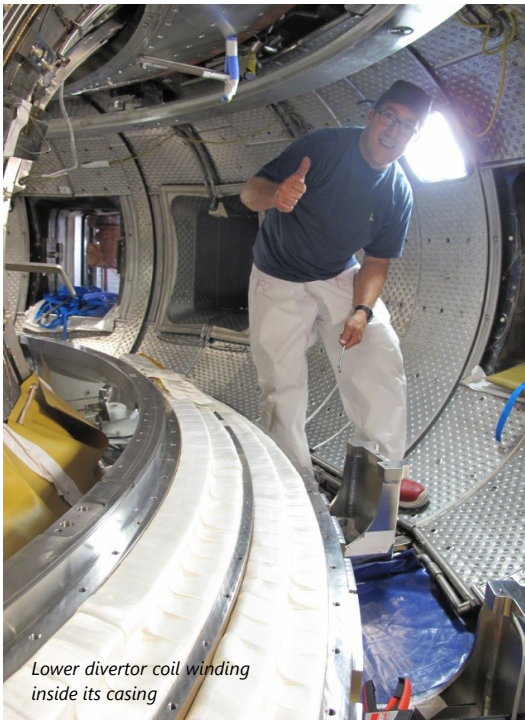
Institute for Magnetic Fusion Research

WEST Newsletter N°14 - September 2016

Final stretch before closing the vacuum vessel

A crucial milestone was reached with the completion of the divertor coil windings. The final worksite phase is now well underway with the installation of the diagnostics and the plasma facing components.

The Tore Supra transformation into WEST is really not a small task! After undressing the tokamak, the most challenging operation was the installation of the in-vessel coils required to achieve the divertor configuration. To drive large current in steady state, the solution of in-situ brazing and insulating of pre-formed conductor stretches was chosen to constitute the coil winding. Specific tooling taking into account the tight environment of the vacuum vessel was developed for the numerous steps of the process. After 6 months of hard work and about 150 brazing, the upper and lower coil windings are now enclosed in their stainless steel casing to the millimeter waiting for resin impregnation. This very last operation will take place after the closing of the vacuum vessel. Before closing the vessel, in-vessel diagnostics like pick-up coils for magnetic measurements, optic fibers and telescopes for spectroscopy are to be installed together with the 30 inner vessel protection panels and 6 inner bumpers. The Radio Frequency antennas will follow on and the upper and lower divertor plasma facing components will end up the assembly phase.



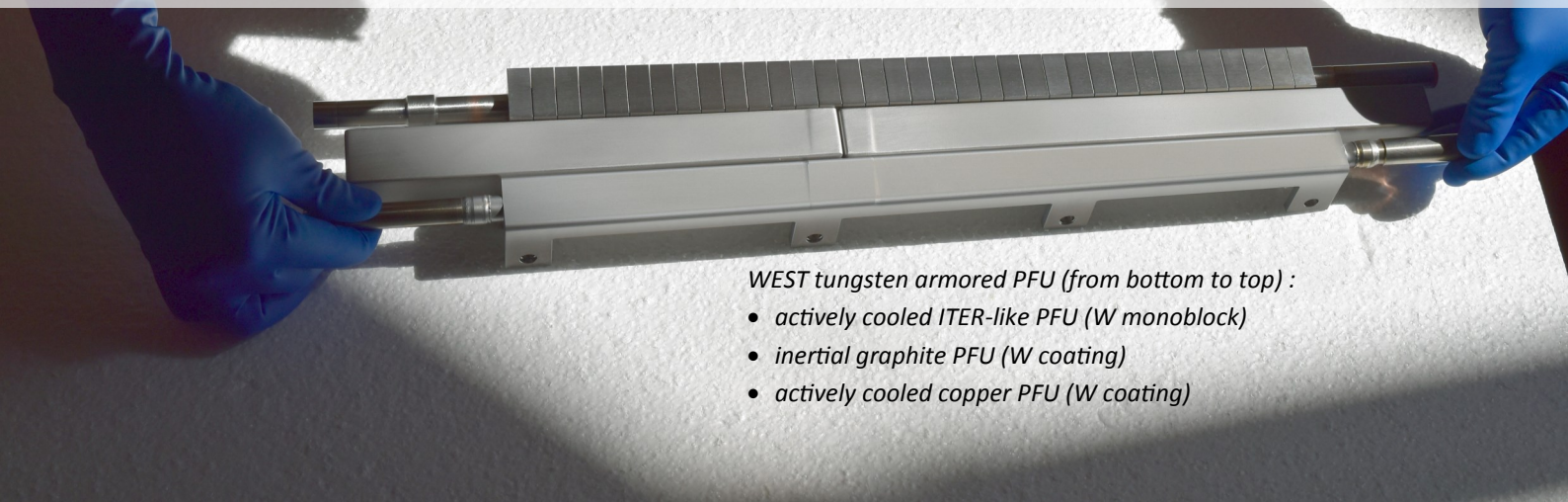
Lower divertor coil winding inside its casing

Several PFU technologies at play in WEST

The first ITER-like Plasma Facing Units (PFU) prototypes are about to be installed in the lower divertor target. They will be surrounded by sacrificial PFU made of inertial graphite with a tungsten coating for the first round of tests.

A couple of Chinese and Japanese ITER-like PFU prototypes have been qualified as well as the nearly 500 graphite PFU that complete the lower divertor target. The graphite PFU were machined in Germany by SGL Company and the 15 µm W-coating were performed in Romania by NILPRP which benefit from a large experience gained from JET and ASDEX Upgrade experiments. Both upper and lower divertor targets are divided in 12 sectors. One sector of the lower divertor will be equipped with the ITER-like PFU from ASIPP and QST to be tested during the first plasma campaigns.

The upper divertor PFU are actively cooled and tungsten armored like the ITER-like PFU but rely on a less complex technology as the upper divertor target will not be exposed to ITER relevant heat fluxes. While the ITER PFU uses a set of small tungsten monoblocks assembled on a hardened copper tube, the upper target PFU uses a single hardened copper monoblock deep drilled for cooling channel and covered by a tungsten coating. The 456 actively cooled PFU of the upper divertor were manufactured in France by SDMS Company and coated by French Startup Company DEPHIS.



WEST tungsten armored PFU (from bottom to top) :

- *actively cooled ITER-like PFU (W monoblock)*
- *inertial graphite PFU (W coating)*
- *actively cooled copper PFU (W coating)*

Join the WEST team for the first experimental campaigns

The call for participation in the first WEST experimental campaigns (C1 and C2 campaigns, planned in 2017) is now open. It has been sent to WEST partners laboratories on August 1st 2016 (deadline for answers set to October 14, 2016). It calls for competencies covering scientific and operational aspects (such as scientific coordinators, session leaders, system operators, or plasma physics experts …).

The C1 campaign (February-April 2017) is focused on exploring heat load patterns and H mode transition in the new WEST environment. The C2 campaign (October-December 2017) will allow further characterizing H mode and testing ITER grade plasma facing components under relevant heat loads.

You will find all information concerning this call for participation on the WEST users portal: https://westusers.partenaires.cea.fr.

For further questions, do not hesitate to contact the WEST contact person in your home lab or the WEST Task Force leaders at west.programme@cea.fr.

2016-2017

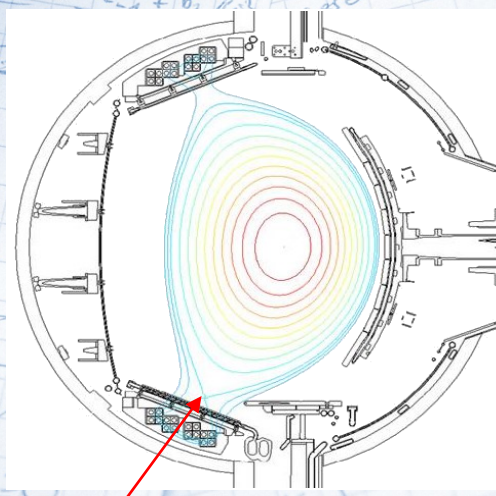
NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
COMMISSIONING			PHASE 1 EXPERIMENTAL CAMPAIGN 1			PHASE 1 SHUTDOWN & RESTART					PHASE 1 EXPERIMENTAL CAMPAIGN 2		

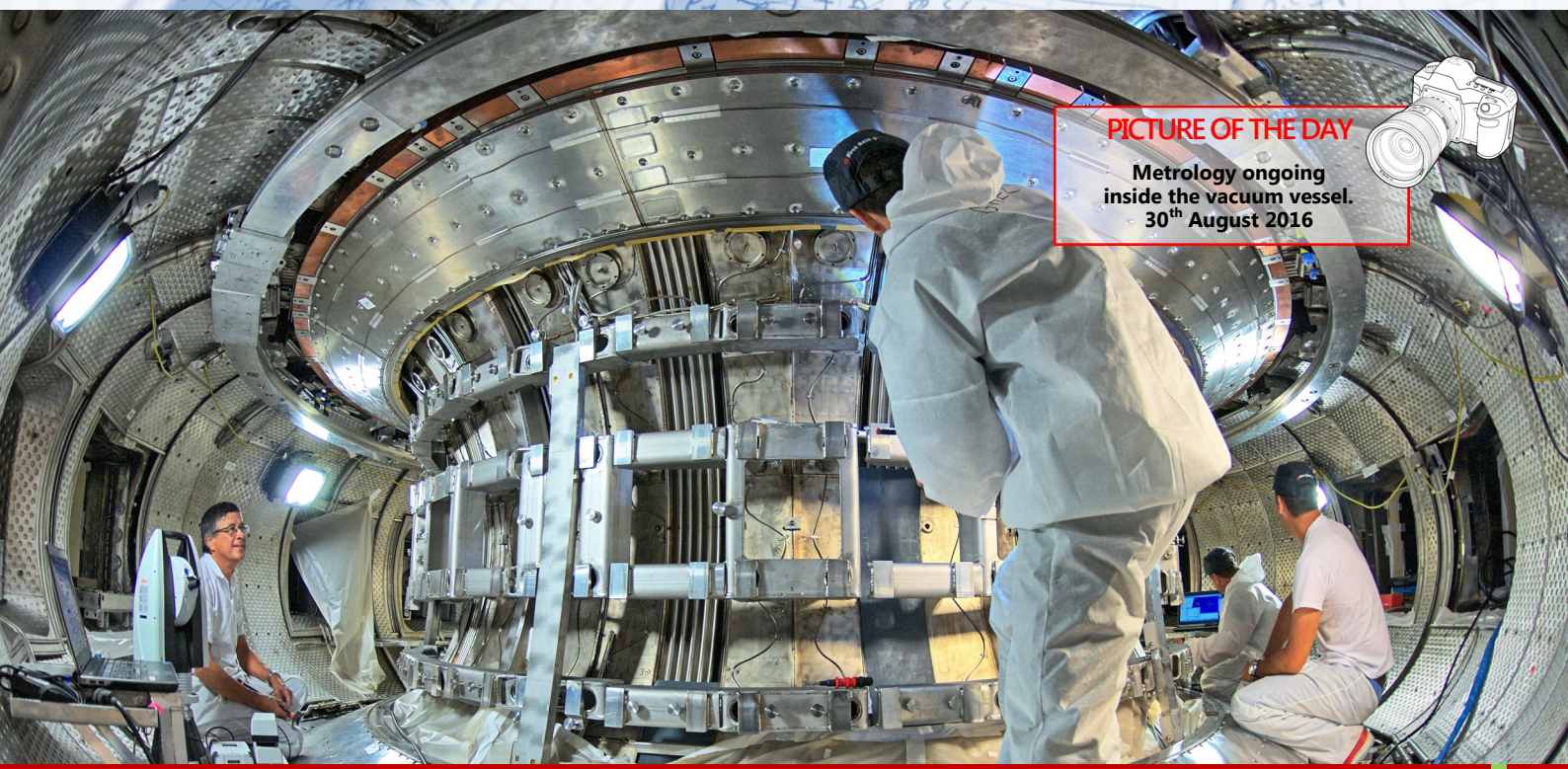
WEST Science

Plasma shape control

In WEST, new coils will produce plasmas with a so-called « diverted » shape, similar to the one that will be used in ITER.

In tokamaks, the plasma is confined inside a set of nested magnetic surfaces with a toroidal topology. The system is always axisymmetric with respect to the vertical axis at the center of the machine but there is some freedom in the choice of the shape of the plasma cross-section. Some shapes, like the so-called "diverted" shape which has been selected for ITER, are better than others in terms of plasma performance. The diverted shape, which requires the presence of a magnetic X point, will be used routinely in WEST, thanks to the addition of two new coils inside the vacuum vessel. This is a major step toward ITER-relevance at IRFM since Tore Supra was previously unable to reach such a shape. In WEST, the plasma shape will be monitored by a set of magnetic field sensors coupled to a sophisticated plasma shape reconstruction algorithm. This information will be used for plasma shape feedback-control. All of this will be done in real time on a millisecond timescale and with a millimetric precision. This will allow, among others, a fine control of the position where the heat flux strikes the tungsten components, which is essential for the success of the project.





PICTURE OF THE DAY

Metrology ongoing inside the vacuum vessel. 30th August 2016

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