THE WEST PROJECT: testing ITER divertor HHF technology in a steady state tokamak environment in close collaboration with partners and stakeholders

A. Grosman and the WEST team

MIIFED, December 04, 2013
Supra conductong coils
Incl. cryogenic plant

Pressurized water loops

RF heating systems
~ 20 MW

Vacuum, safety, CODAC, Control systems, …
PLASMA FACING COMPONENTS
DEVELOPMENT AND INTEGRATION @CEA

CIEL “FINGER”

Mock ups for HHF tests

INTEGRATION IN TORE SUPRA
PROGRAMMATIC ISSUES IN TORE SUPRA

PLASMA

10^{-3}  10^{-2}  10^{-1}  10^{0}  10^{1}  10^{2}  10^{3}  10^{4}  10^{5}  10^{6}

- MHD
- Energy confinement
- ELMs - Disruption
- Particle confinement

POWER

MATTER

- Plasma performance

Reflected light

Simulation of IR Image

Experimental IR Image

IR view of Tore Supra LHCD launcher in Ohmic plasma

Tore Supra

Return on Investment

PFC lifetime

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2 risks types for the ITER divertor

Risks with ITER divertor procurement

New technology facing industrialization

Risks with ITER divertor operation

No experience with actively cooled divertor

WEST addresses both of them
FROM LIMITER CONFIGURATION TO DIVERTOR CONFIGURATION

- **Limiter configuration**
- **Divertor configuration**

- **Carbon**
- **Tungsten**
WEST PLASMA FACING COMPONENTS

- **Bumper**
  - CFC/W-coating

- **Upper target**
  - Cu/W-coating
  - up to 5 MW/m² (steady-state / double null)

- **VDE/ripple protection**
  - Cu/W-coating

- **Water cooled Stainless steel panel**

- **Lower target**
  - "ITER Technologies"

- **Baffle**
  - Cu/W-coating
  - up to 3 MW/m² (steady-state)

- **VDE/ripple protection**
  - Cu/W-coating

- **Antenna Limiters**
  - CFC/B-coating

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**ITER requirement** (and beyond)

* 10 MW/m² in steady state
* 20 MW/m² in slow transient (< 10s)
WEST AND ITS PARTNERS

- June 2012: Support from ITER O. DG (letter to CEA CEO)
- Jan 2013: China National Nuclear Corporation (associated lab.)
- July 2013:
  - Chinese Academy of Sciences (associated lab.)
  - India Department of Atomic Energy
  - IPPLM Pologne
- Sept 2013:
  - US-DOE (Letter of Intent)
- Oct 2013:
  - Fusion For Energy (Europe)
  - JAEA-JADA (Japan)
- (very soon):
  - Korea
  - EUROFUSION, IPP, FZJ

Chengdu, Jan. 2013
Beijing, July 2013
Warsaw, July 2013
Ahmedabad, July 2013
Cadarache, Oct 2013
Cadarache, Oct 2013
Washington DC, Sept. 2013
THANK YOU FOR YOUR ATTENTION