



RACE (part of UKAEA)

Remote Applications in Challenging Environments

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RACE Mission

- RACE is the **UKAEA's** centre for Remote Applications in Challenging Environments.
- Working towards challenging environments no longer being a barrier to human endeavour.
- Building on 20 years of remote operations at **JET**.
- UKAEA Board has agreed that RACE will be the delivery vehicle for all the UKAEA's R&D and commercial activities in the field of robotics and autonomous systems (**RAS**).
- To engage with industry to deliver robotics for **fusion power** and to increase the UKAEA's wider contribution to **UK plc**.
- The impact of successful delivery will be **new jobs and growth in the private sector**, both fusion and non-fusion.

Background

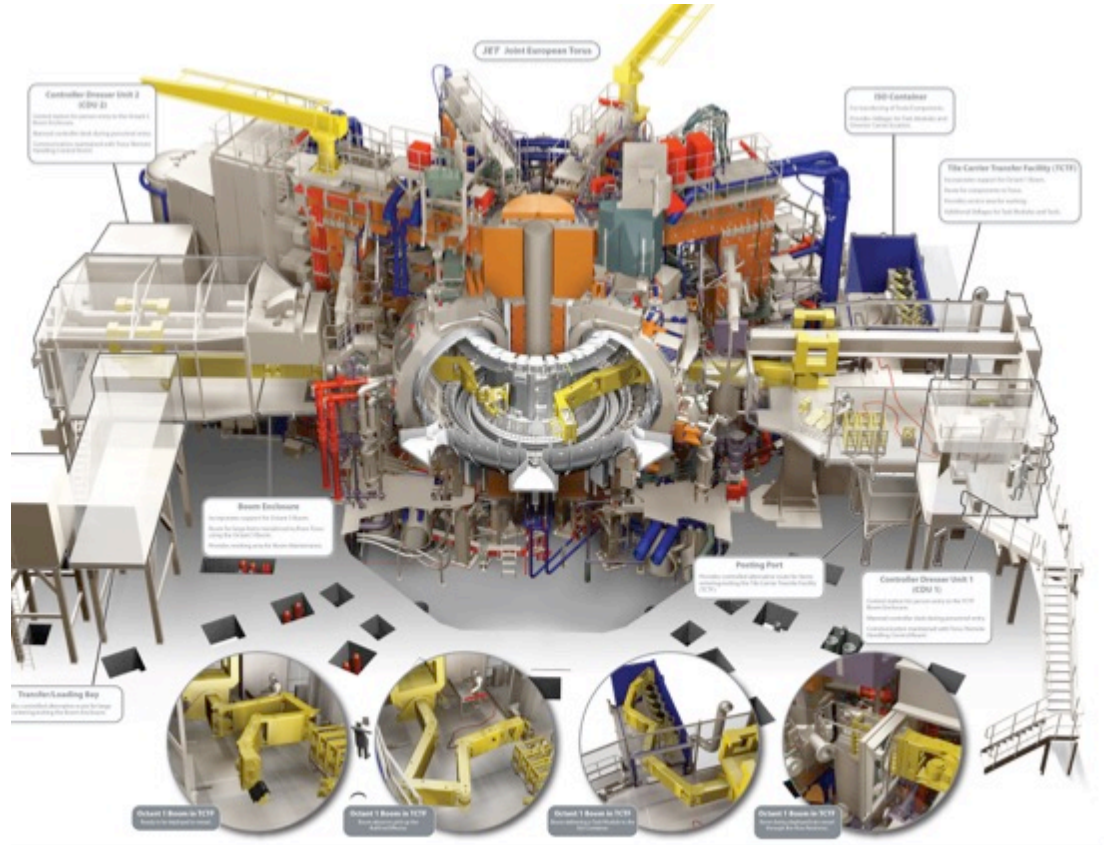
- JET has the only fully integrated operational fusion remote handling system in the world.
- With over 20 years and 30,000 hours of remote operations. Team size now 80.
- Practical experience in the design of components, tools, equipment and procedures – solutions.
- Resulting in requests to support international fusion development projects: ITER, DEMO and CFETR.



(Courtesy of EUROfusion)

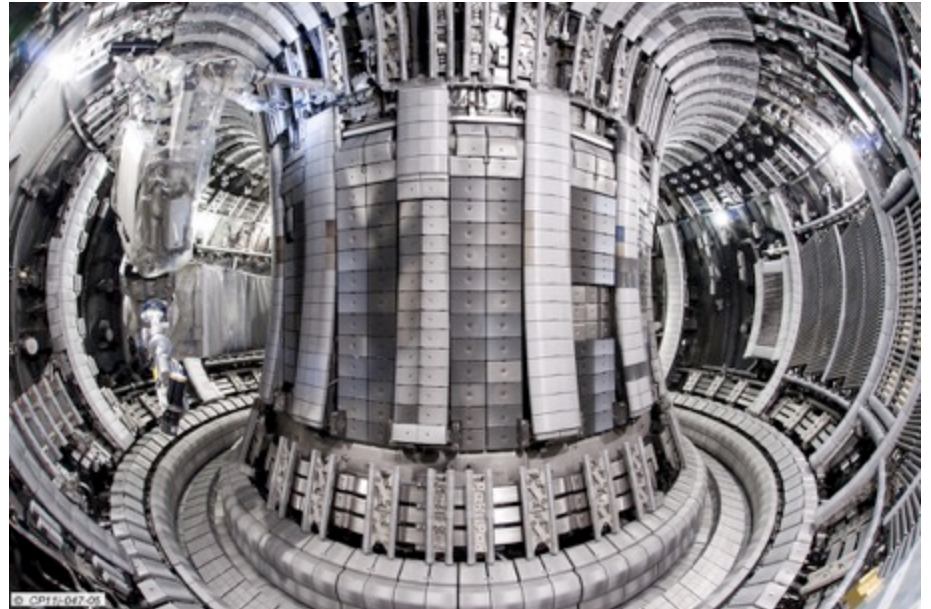
Integrated system

- Manipulators
- Transporters
- Tooling
- Haptics and HMIs
- Control systems
- Control room
- Virtual reality GUIs
- Operations procedures
- Tooling logistics
- Comms infrastructure
- Data storage
- Service infrastructure
- Contamination control
- Spares
- Maintenance



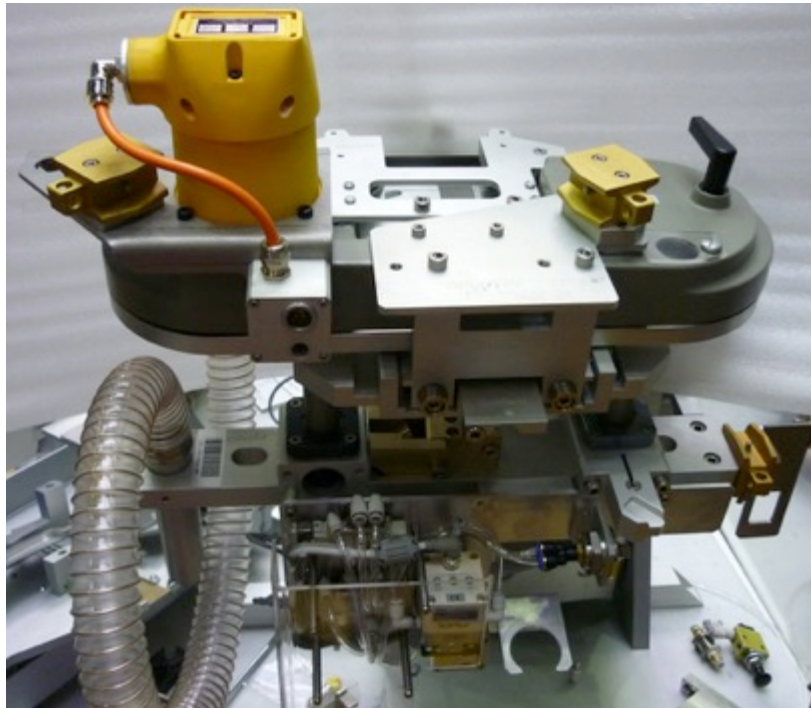
ITER-like-wall project

- ILW shutdown involved remotely handling 7000 assemblies
- 24/7 remote operations for 17 months
- 350 new types tools and jigs designed for a variety of applications:
 - Tile handling
 - Cutting
 - Welding
 - Inspection

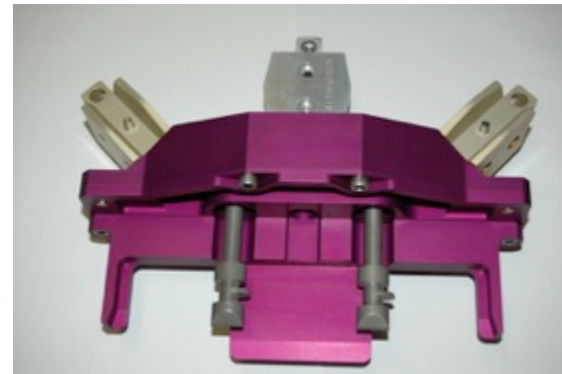
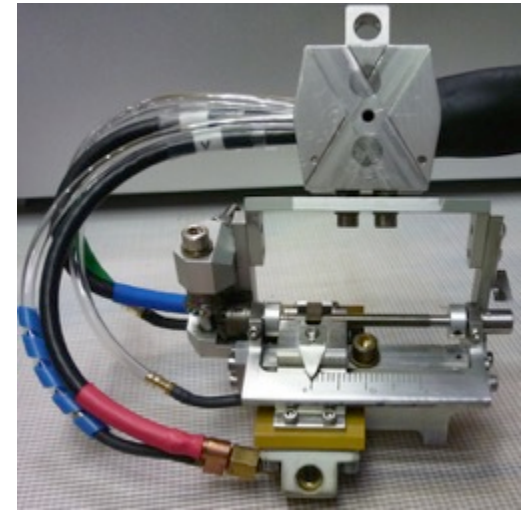
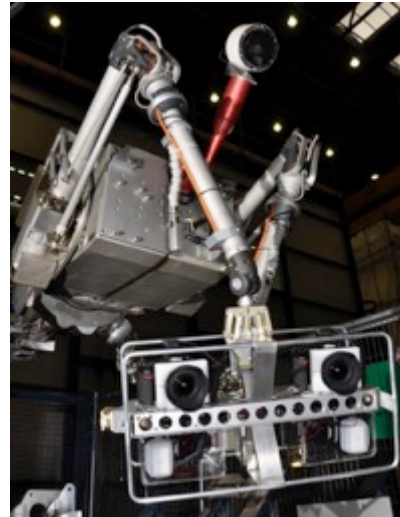


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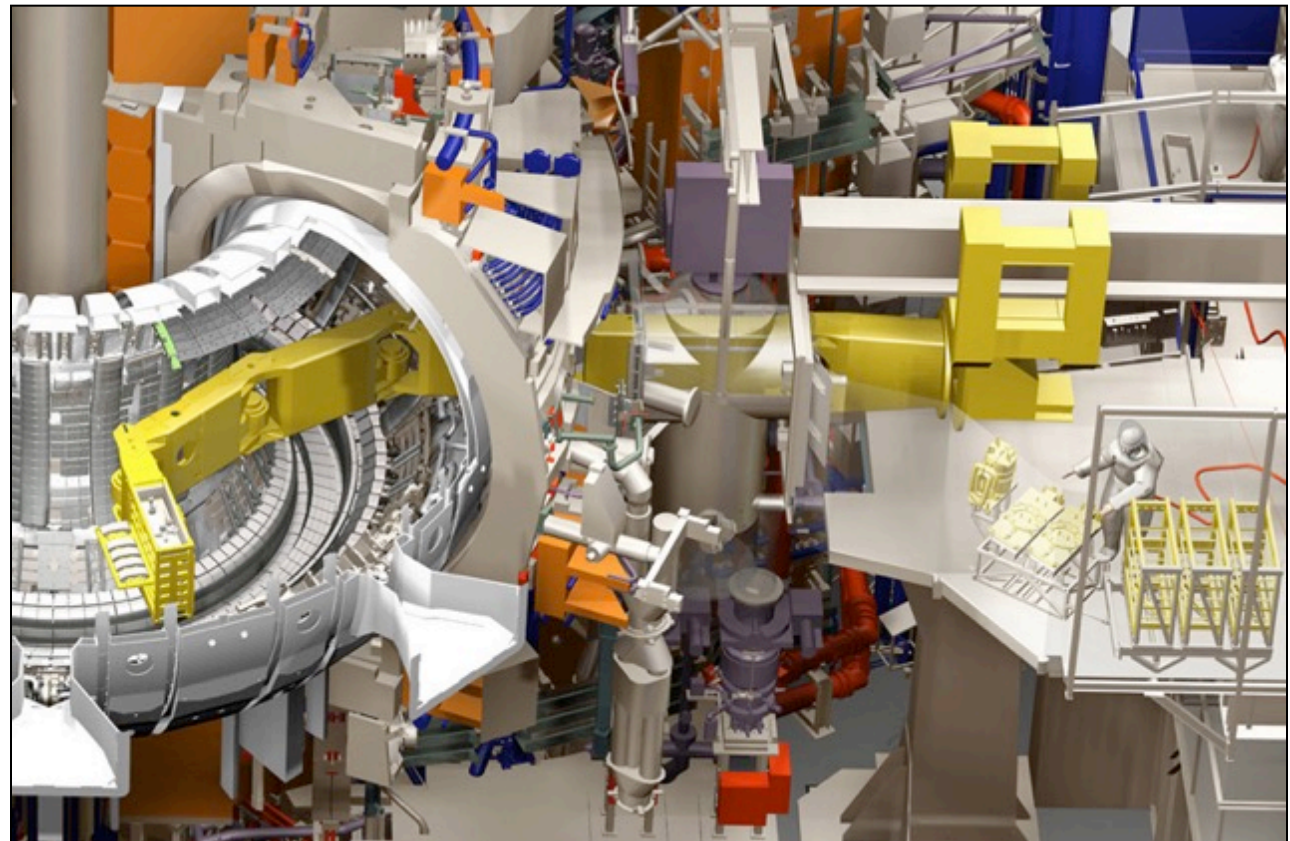
Specialised tools



(Courtesy of EUROfusion)



Modelling and planning



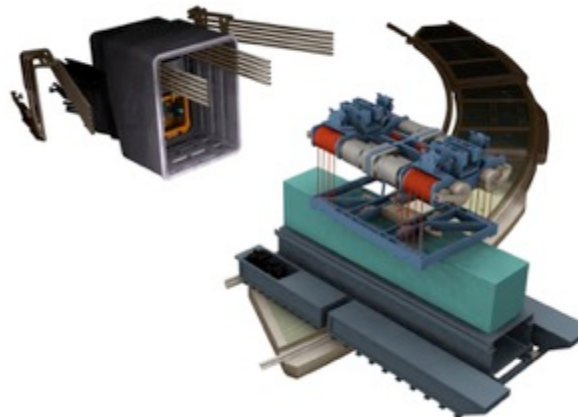
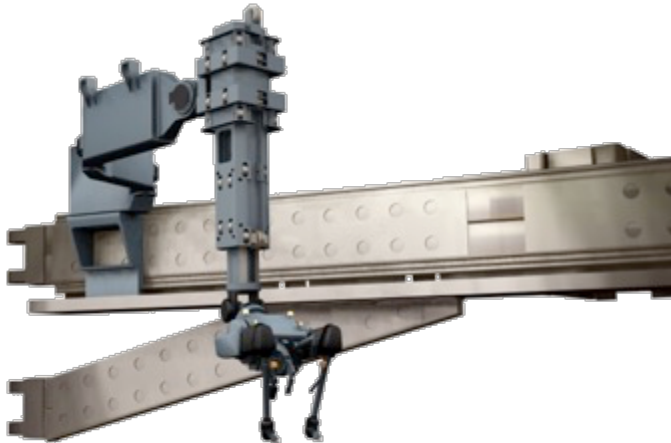
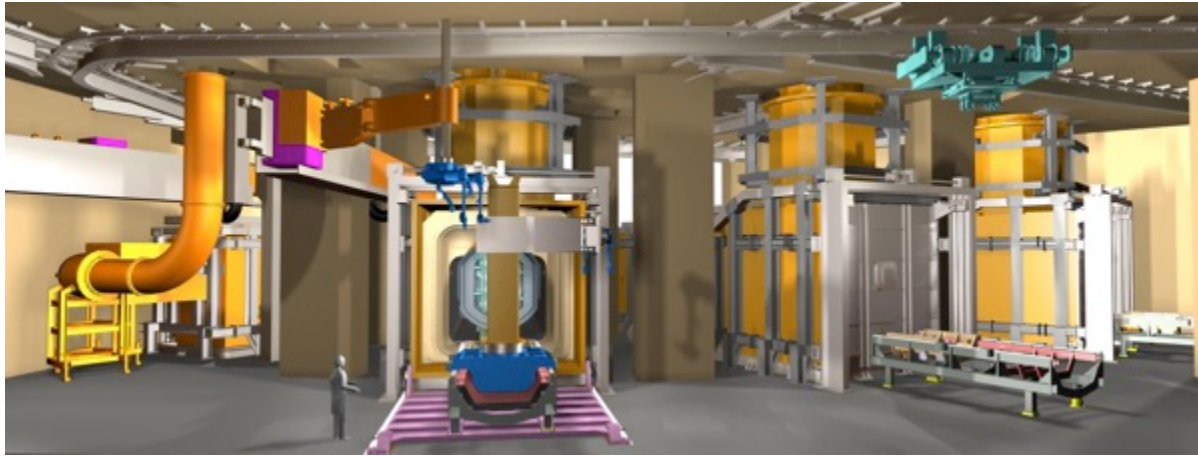
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ITER – ‘£1billion’ of RH



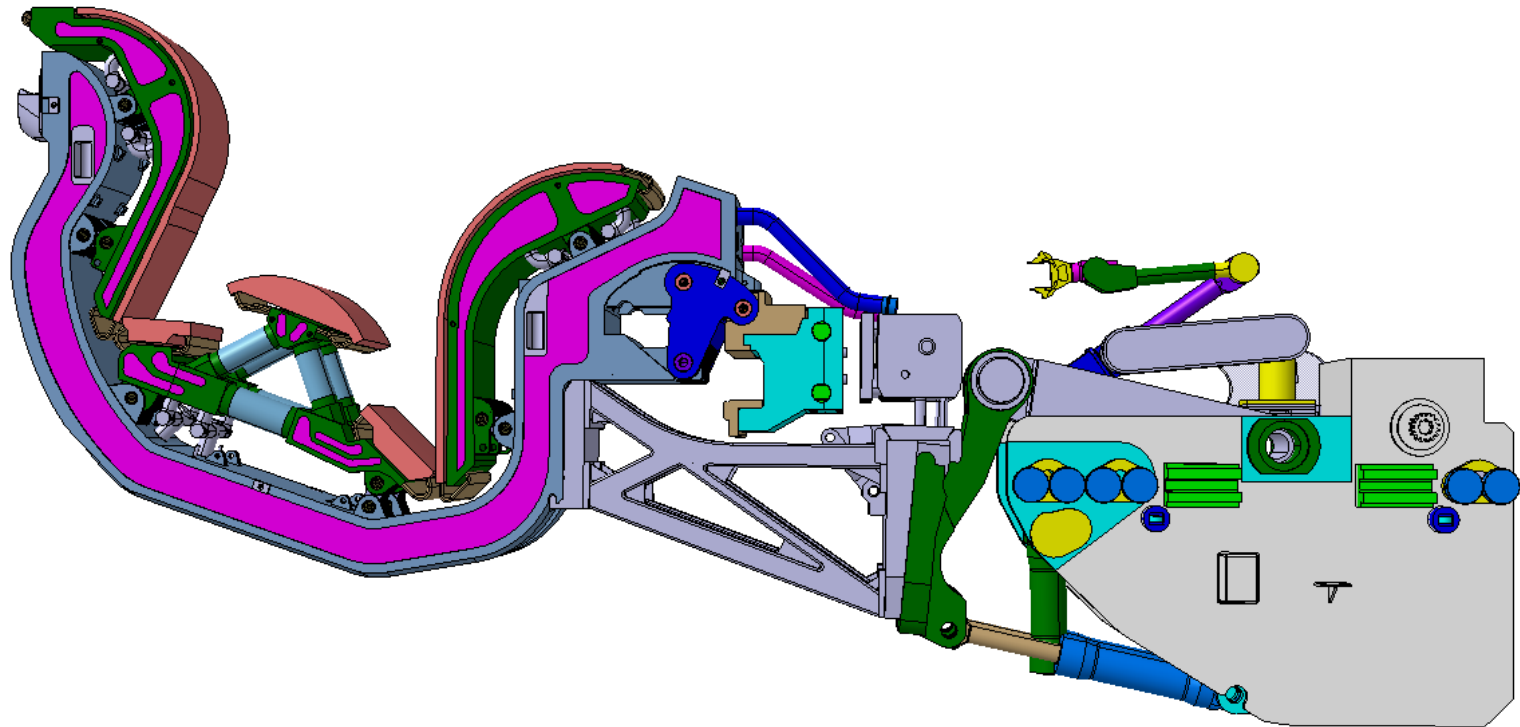
ITER Neutral Beam RHS

Part of the industrial team contracted by F4E to deliver the ITER NB RHS.
Group is led by AMECFW and includes RACE and 7 other partners



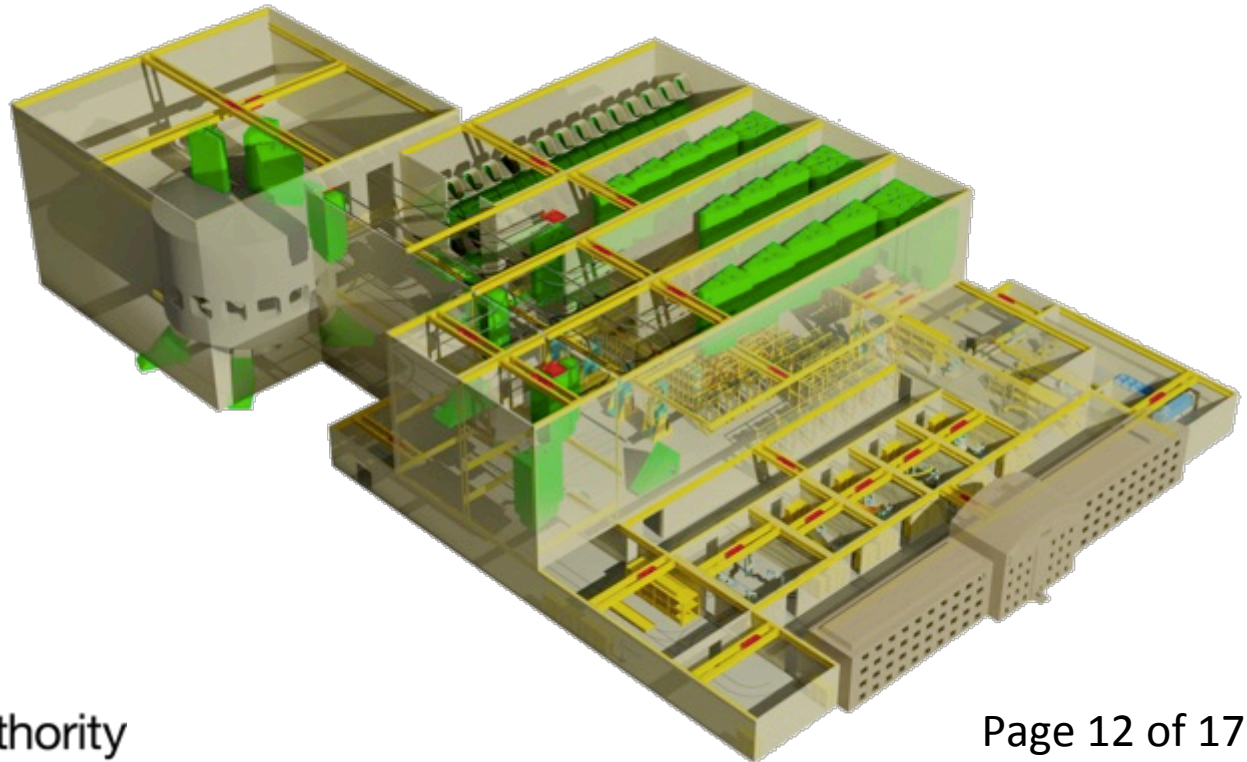
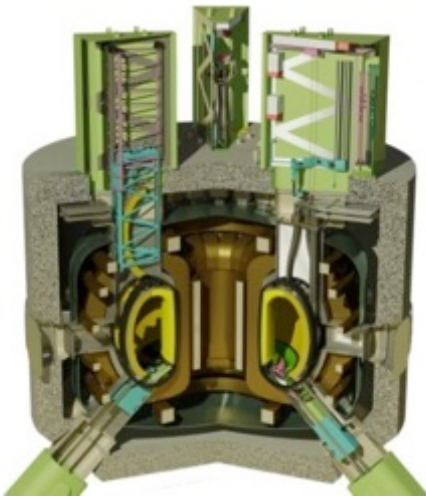
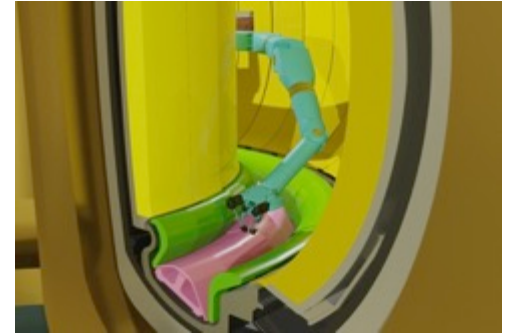
ITER Divertor RHS

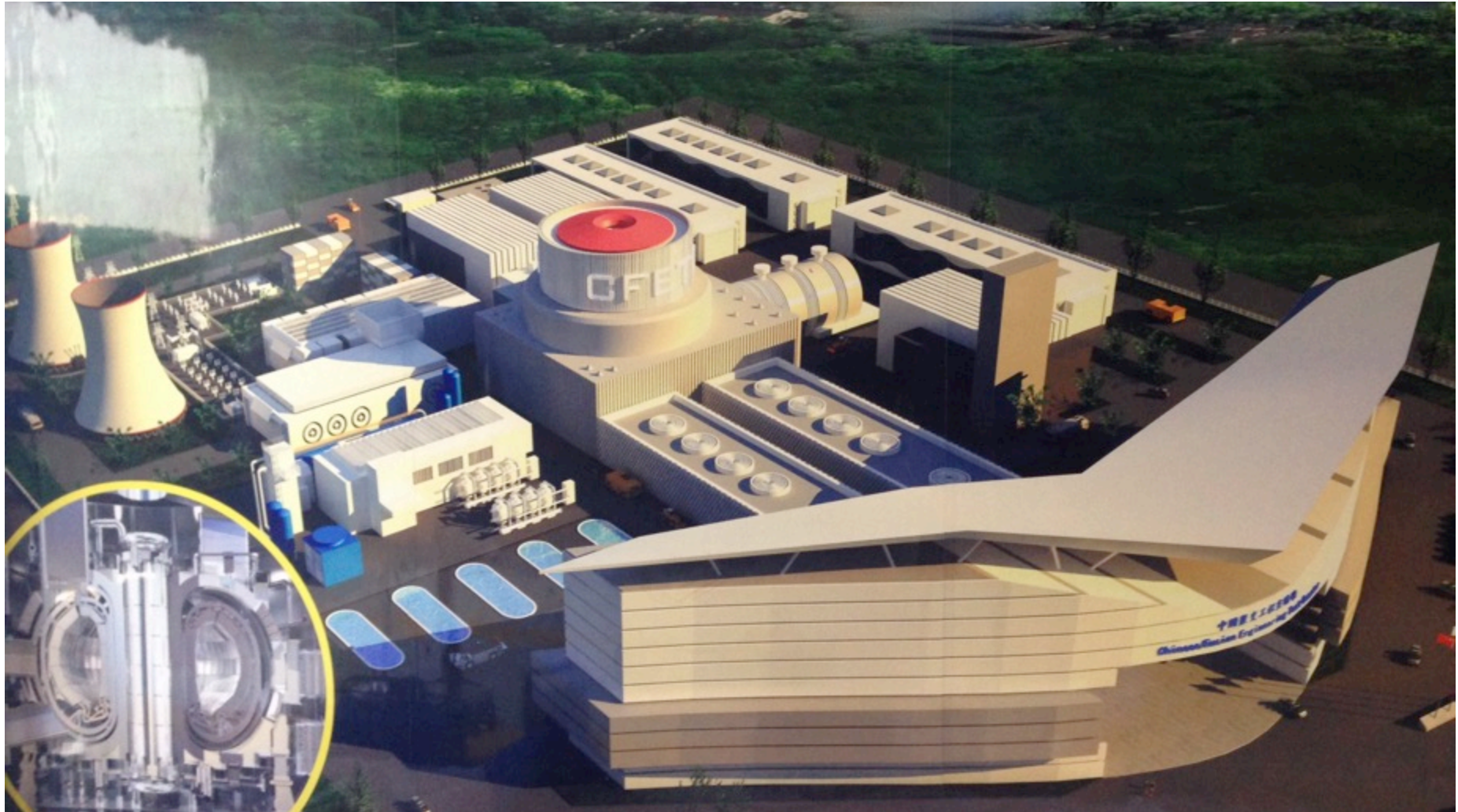
- Part of the industrial team contracted by F4E to deliver the ITER Divertor RH system. Group is led by Assystem UK and includes RACE, SMD, VTT & TUT



Fusion power reactor

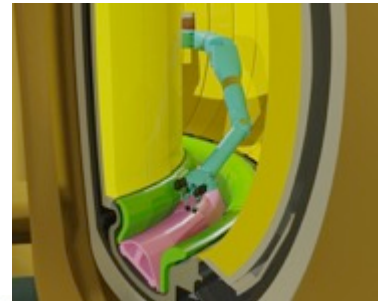
- The ultimate challenging environment
- Extreme levels of radiation: kGy/hour
- Elevated temperature: $>500\text{K}$
- Magnets 'not-off': 10T magnets idle mode
- 'Partial' vacuum





High level R&D roadmap

- Collaborating with the best...
- Process
 - Conducting work in the challenging environments
- Delivery mechanisms
 - Integrated technical products
- Control
 - Real world operation
- Complete solutions and standards
 - Safe, cost effective service delivery
 - Verify, train, operate



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