FUSION FOR ENERGY

HIGHLIGHTS 2014

THE MAIN ACHIEVEMENTS

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Background

The European Union is the largest energy importer in the world. It is estimated that 53% of its energy supply comes from abroad at a cost of around 400 billion EUR. Approximately 1 trillion EUR needs to be invested into our energy sector by 2020 so that we meet the needs of generation, transport and distribution. The way we plan to address this field of strategic importance will have tremendous implications on the way we live, prosper and innovate.

A diversified, sustainable energy mix is high on the agenda in order to fight climate change. We need to use our fuel resources in an optimal manner and start becoming self-sufficient. We need vision in order to take into consideration the contribution of fusion energy in a few decades from now. The fuels needed for fusion are widely available and virtually inexhaustible. With fusion there are neither greenhouse gas emissions nor long-lasting radioactive waste. Furthermore fusion reactors, which should be capable of generating large amounts of electricity, are intrinsically safe with no risk of a chain reaction.

Fusion for Energy (F4E) is the European Union organisation managing Europe's contribution to ITER, the biggest international collaboration in the field of energy that will demonstrate the viability of fusion. The project brings together half of the world's population (China, Japan, India, the Republic of Korea, the Russian Federation and US) and represents 80% of the global GDP. The host party of this one-of-a-kind scientific endeavour is Europe and it contributes close to one-half of the ITER components. F4E is also responsible for the coordination of the European contributions to three joint fusion projects carried out in collaboration with Japan, known as the "Broader Approach", which will offer us better insight in this field.

Europe's higher contribution to ITER means more work and opportunities for industry, SMEs and fusion laboratories that wish to get involved. Through their participation they will broader their expertise; develop a more competitive profile, become familiar with cutting edge technologies and last but not least, gain access to an energy market that promises to generate substantial financial benefits.

In 2014 F4E signed contracts with European economic operators exceeding a total value of 400 million EUR, bringing the total value of contracts awarded since 2008 to 3 248 billion EUR. In parallel, 86 new procurement tenders and smaller value contracts were launched in order to proceed with the ITER construction and the manufacturing of our share of components.

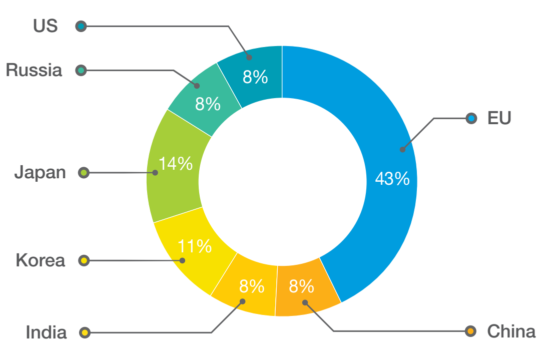
With regards to the ITER construction, a symbolic milestone has been celebrated with the completion of the foundation of the floor upon which the biggest fusion machine in the world will rely on. This landmark achievement has marked the conclusion of the works that started almost four years ago and represent an investment of around 100 million EUR for F4E. The floor will be able to support more than 400 000 tonnes of buildings infrastructure and equipment, including the ITER machine weighing 23 000 tonnes - three times the weight of the Eiffel Tower.

In terms of manufacturing, F4E together with its suppliers have worked hard to make significant progress in several fields where Europe has an important say. For example, we have accelerated the production in the field of magnets, which are essential for the magnetic confinement of the super-hot plasma. Progress has also been made in the area of heating systems, in order to get the fusion fuel to reach 150 million° C, ten times the temperature at the core of the sun. We have also opened a new chapter in the area of high-tech robotics and virtual reality platforms by signing our first industrial contract in remote handling and carrying out successfully the first full installation and removal sequence for a prototype under conditions similar to ITER. Another important development has been our contribution to the ITER cryoplant, which will be the biggest in the world, to cool down the machine to temperatures as low as -269° C. Europe is the biggest supplier of all parties in the area diagnostics, known as the eyes and ears of scientists in the device, where we have managed to involve more than 28 laboratories in the design process.

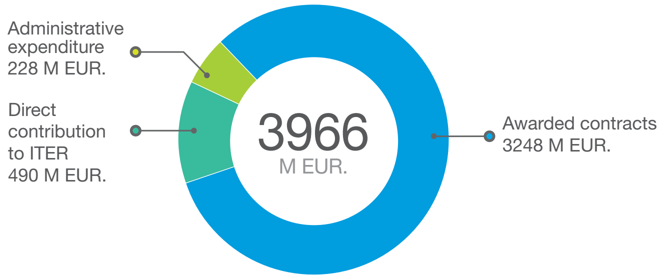
Last but not least, we have honoured our commitment to engage with our stakeholders at different levels in order to keep them abreast of the latest developments through conferences, technical briefings or high-level meetings. To convey the achievements and challenges that we faced in 2014, we have prepared this publication so that you learn more about this fascinating project.

2014 Key figures

In-kind contributions to ITER



Total contributions between the different ITER parties - 2014



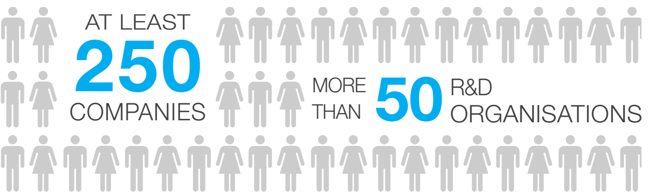
Breakdown of EU contribution to ITER 2008-2014

Value and quantity of awarded contracts

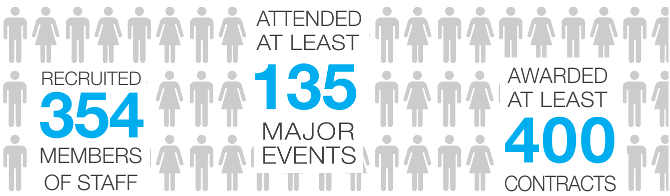
Annual and summed value of contracts awarded
(>1 Million EUR)

Number of contracts signed

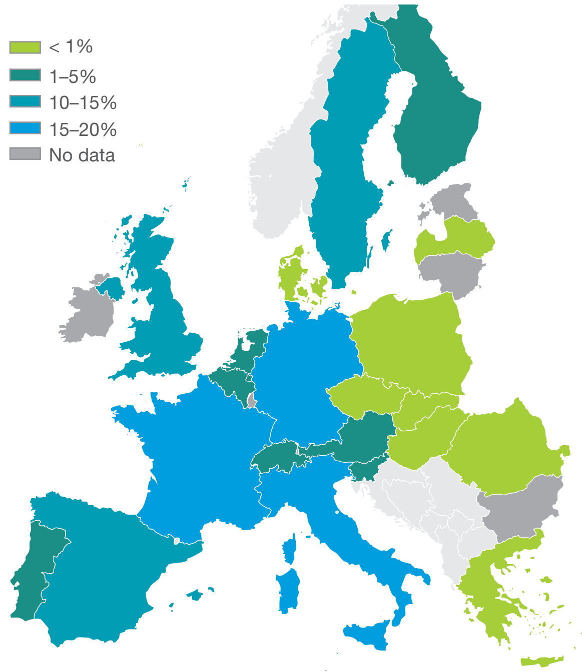
Since 2008 F4E has been collaborating with:

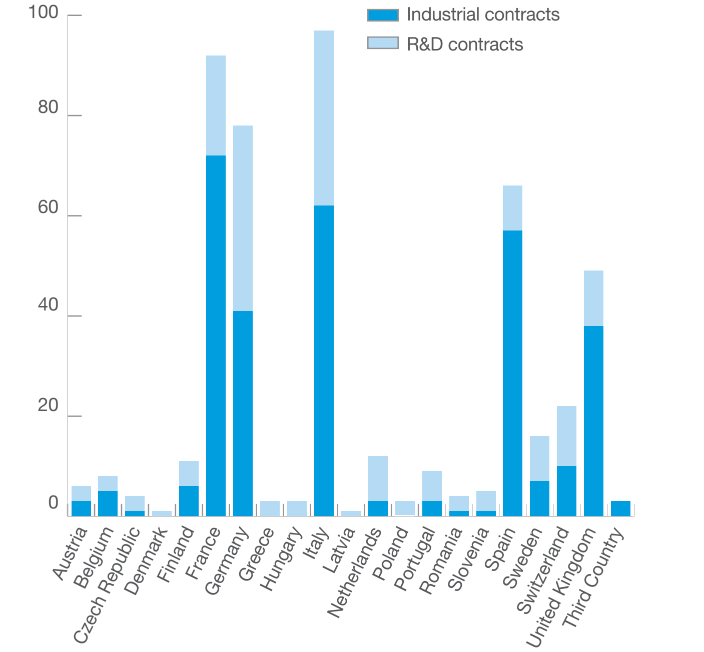


Since 2008 F4E has:

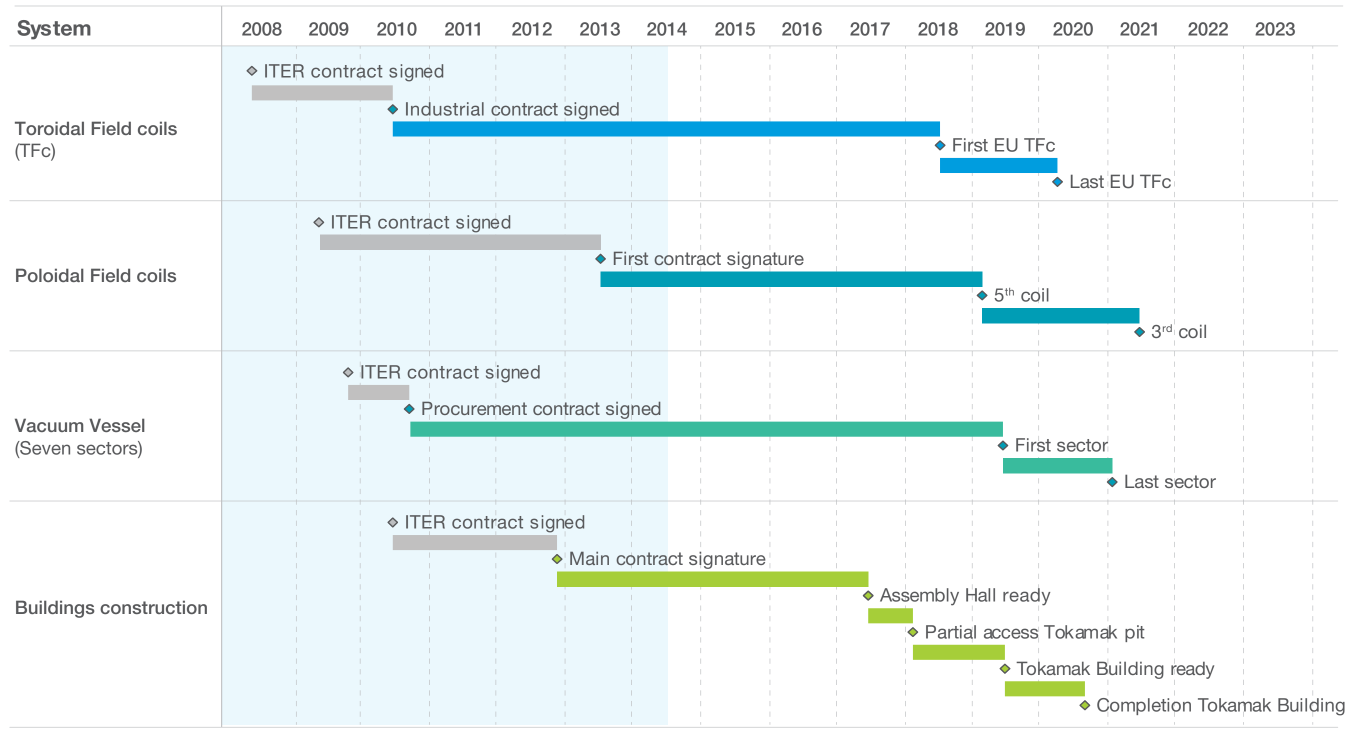


Geographical distribution of contracts awarded by F4E





Progress of the work for the main components provided by F4E



2014 at a glance

January

Manufacturing started for the first out of the 70 radial plates for the Toroidal Field coils.
Danish companies met with F4E suppliers to explore their involvement in key technical areas.

February

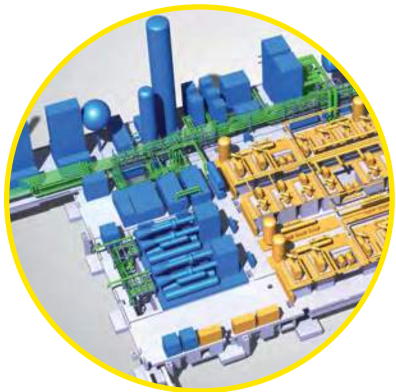
Nuclear safety workshop brought together specialists to discuss regulation applicable to ITER.
Industry meetings in Croatia and Malta were organised to highlight ITER business opportunities.

March

F4E signed a contract for the power supplies for the Electron Cyclotron system with Switzerland's first ever SME contributing to ITER. Works for seven new buildings started on the ITER construction site.

April

The ELISE (Extraction from a Large Ion Source Experiment) facility, operating at the Max Planck Institute for Plasma Physics, reached the current density target set for deuterium hydrogen operation, meeting the requirements of ITER's beam source as part of the heating system.



May

F4E signed a contract with Air Liquide to equip the world's biggest cryoplant that will cool down the ITER machine to temperatures as low as -269° C.
Several European laboratories agreed to collaborate in the field of Diagnostics.

June

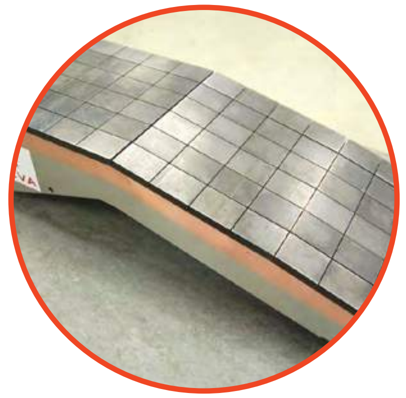
Multimillion contract in the field of Remote Handling system was signed with Assystem.
Europe's final Toroidal Field coils contract was awarded to SIMIC S.p.A.
Factory Acceptance Tests of the Ion Source and Extraction Power Supplies (ISEPS) were completed successfully!

July

J.M Durão Barroso, President of the European Commission, visited ITER. The consortium of companies consisting of Vinci, Ferrovial and Razel made further progress vis à vis the construction of the Tokamak Assembly Hall building.

August

The basemat of the Tokamak complex was constructed. A landmark achievement marking the conclusion of the preparatory phase of the ITER construction site.



September

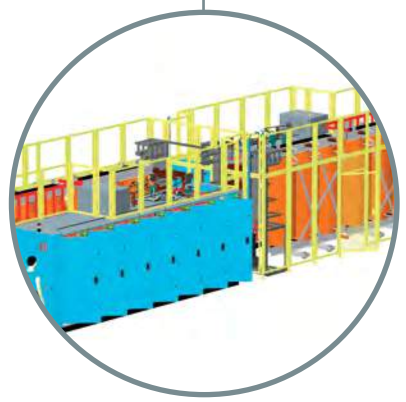
F4E signed contracts related to the manufacturing of the first full-scale prototypes for the ITER Blanket First Wall. F4E reported to the fusion community the progress of Europe's contribution to ITER at the Symposium on Fusion Technology (SOFT).

October

F4E in collaboration with Bruker European Advanced Superconductors and Oxford Superconducting Technology concluded the production of the superconducting wire for the Toroidal Field coils.
The fabrication of the vacuum vessel for the SPIDER facility in Padua was completed together with the factory acceptance tests.

November

The Linear IFMIF Prototype Accelerator, one of the Broader Approach projects, achieved its first plasma and ion beam extraction.



December

Final design review completed for ITER's Electron Cyclotron system.
F4E participated to EU Italian Presidency event to highlight the innovation potential of ITER.

01

Building ITER

Landmark contracts have been signed and major woks have started.
The ITER platform is one of the largest man-made levelled surfaces in the world and is considered as one of the biggest building sites in Europe measuring 42 hectares.
The party responsible for the construction of 39 buildings on the site, is Europe.
Currently, the personnel directly involved in construction counts at least 400 people and by mid-2015 it is expected to reach 1,000.
One of the key challenges will be to accommodate the rapidly growing workforce and to guarantee an optimal use of space by the different companies operating on the ground, in order to carry out the construction of all infrastructures in parallel and on time.

The ITER site
December 2014

The first floor of the Tokamak complex has been completed

An achievement widely considered as important for F4E and the rest of the ITER parties. The completion of the first floor of the Tokamak complex has marked the end of a major civil works contract and the beginning of the construction phase.

This has been the final chapter of the preparatory works carried out at the Tokamak slab which started in August 2010 and represent an investment of around 100 million EUR for F4E. This significant milestone has come as an addition to the completion of the galleries around the Tokamak pit, the temporary road network, the contractors' area and the underground networks. During the last four years, the work on the construction site has been challenging for all parties involved in the project especially for ITER International Organization,F4E and its contractors.

"The design and validation process have been extremely challenging because of the difficulty to combine all requirements in a sound and practical way" explained Miguel Curtido, F4E's Technical Project Officer. The first floor is part of the shielding and confinement barrier of the future Tokamak, and as such it is considered a "Protection Important Component" (PIC), subjected to heavy scrutiny from both ITER Organization and the French Nuclear Regulator. This has been the first concrete which had to comply with the full set of nuclear safety requirements.

It is worth remembering that ITER will be the biggest nuclear facility in France and the first-ever nuclear fusion facility. The combination of high density reinforcement in the central area (around 350 kg/m^3), with interfaces of orthogonal and radial layouts, combined with a large reinforcement diameter (40 mm) and extremely tight tolerances for the placement of the embedded plates (up to 3 mm in some cases), made the execution very challenging. "The main priority for all teams has been to ensure maximum safety and quality levels given the complex construction and the tight schedule", explained Miguel Curtido.

The concrete pouring of this huge slab, covering an area of 9 600 m^2, started in December 2013. The hold point was released by the French Nuclear Authority on July 2014, and the central 9 sections of the slab were poured within 7 weeks. This was made possible thanks to the personal commitment of all the people involved, working during the holiday period, night shifts and weekends when necessary.150 workers have used 14 000 m^3 of concrete, 3 600 tonnes of steel and 2 500 embedded plates in total.

Ben Slee, F4E Technical Officer responsible for the building construction elaborated: "Those who have been working on the construction site and hundreds of others in the areas of design, procurement, schedule, quality assurance and finance have contributed to this important achievement".

"We have learnt a lot from this phase: we now have a better understanding of the construction interfaces and can draw lessons for improvement. This learning curve has definitively equipped us with sound knowledge to carry out the rest of the construction phase." explained Laurent Schmieder, F4E's Project Manager for ITER Site, Buildings and Power Supplies.

During the construction site preparation works, F4E has also awarded contracts that have exceeded the value of 1 billion EUR in the field of construction. The Architect Engineer has also developed a tender design approved by ITER International Organization for all the buildings (except the Hot cell and surrounding buildings) and has prepared the construction design for the Tokamak building up to Level 1.

The last quarter of 2014 has brought many changes on the ITER construction site. The Vinci – Ferrovial – Razel (VFR) consortium, has begun the construction of the B2 slab level walls of the Tokamak complex; the erection of the steel frame of the Assembly building as well as 12 new surrounding buildings around the Tokamak complex.

> *"The conclusion of this task is a historical moment for the project. Years of hard work by all ITER parties are bearing fruit as the facility takes shape and makes progress on all fronts"*
>
> **Professor Osamu Motojima**
> Director General of ITER International Organization

The first floor of the Tokamak complex has been completed

Hundreds of workers have been involved in the construction of the B2 Slab.

The ITER basemat in figures

The basemat is far more complex that it seems. It has a surface of 9 600 m^2 and a thickness of 1.5 m of reinforced concrete consisting of four successive layers - two of 50 cm, one of 30 cm and one of 20 cm.
In total 150 workers were involved in this operation, using 14 000 m^3 of concrete, 3 600 tonnes of steel and 2 500 embedded plates.

A web of 493 plinths coated with pads, lies beneath the upper slab, able to absorb the effect of an intense seismic shock.

The infrastructure fully complies with the set of nuclear safety requirements branding ITER as the biggest nuclear facility in France and the first- ever nuclear fusion facility in the world.

Ready to build the Assembly Hall of the Tokamak

The consortium made of Vinci, Ferrovial and Razel (VFR) has started the construction of the Tokamak Assembly Hall building in August 2014. The building, adjacent to the Tokamak complex, will be 60 metres high and will host two 750 tonne cranes that will assemble the components of the ITER machine. The work has been part of the construction contract for the Tokamak complex signed in 2012.

In April 2012, works kicked off with the drilling of boreholes and the extraction of 12 000 m^3 of soil and rock. Reinforcement works and the pouring of concrete for the 6 000 m^2 basemat followed which lasted roughly one year.

The construction of the impressive steel-structure will be realised in 15 steps from the erection of columns for the structure foundations to the assembly of the roofing in the ground floor. The works are expected to end around autumn 2015.

Assembly Hall area
May 2013

Assembly Hall area
October 2014

Assembly Hall building key figures

12 000 m^3 of soil extracted during the excavation phase.
Future building dimensions: 97 x 60 metres

Function
Location of pre-assembly activities for the ITER device. To host custom-made tools as well as two 750-tonne cranes.

Assembly Hall area
Artistic view by VFR

© ITER IO

The ITER platform is 42 hectares and Europe is the party responsible for the delivery of the 39 buildings that the ITER platform will host. In 2014, 400 people were directly involved in construction and by the end of 2015 the number is expected to double.

ITER site to welcome seven new buildings

ITER construction has been accelerating thanks to the signature of two contracts between F4E, and Ferrovial Agroman.

Seven new buildings will be added to ITER's construction puzzle to house facilities and a range of high technology components that will be used in the biggest fusion energy project. The budget of the two contracts is in the range of 40 million EUR and the works are expected to be completed in the next four years.

The ITER construction has reached a turning point. With more companies participating and more workforces deployed it is expected to become one of the busiest worksites in Europe. For Alejandro de la Joya, CEO of Ferrovial Agroman, “these two contracts offer Ferrovial Agroman the opportunity to be further involved in ITER and establish itself as one of the most committed contractors. We are extremely proud to be part of the most ambitious international collaboration in the field of energy”.

“We are extremely proud to be part of the most ambitious international collaboration in the field of energy”

Alejandro de la Joya
CEO of Ferrovial Agroman

The scope and key figures of the two contracts

The ITER magnets will need electricity in order to generate the powerful magnetic cage that will confine the hot plasma. Through this contract, two magnetic power conversion buildings will be constructed, with a surface of 4 900 m^2 and a volume of 39 000 m^3 each. They will house the components manufactured by China, the Russian Federation and the Republic of Korea that will convert alternative current to direct current which will be used by the ITER magnets. A smaller building will also be constructed, in order to house the components that will provide the compensation of the reactive power for the operation of the electrical network.

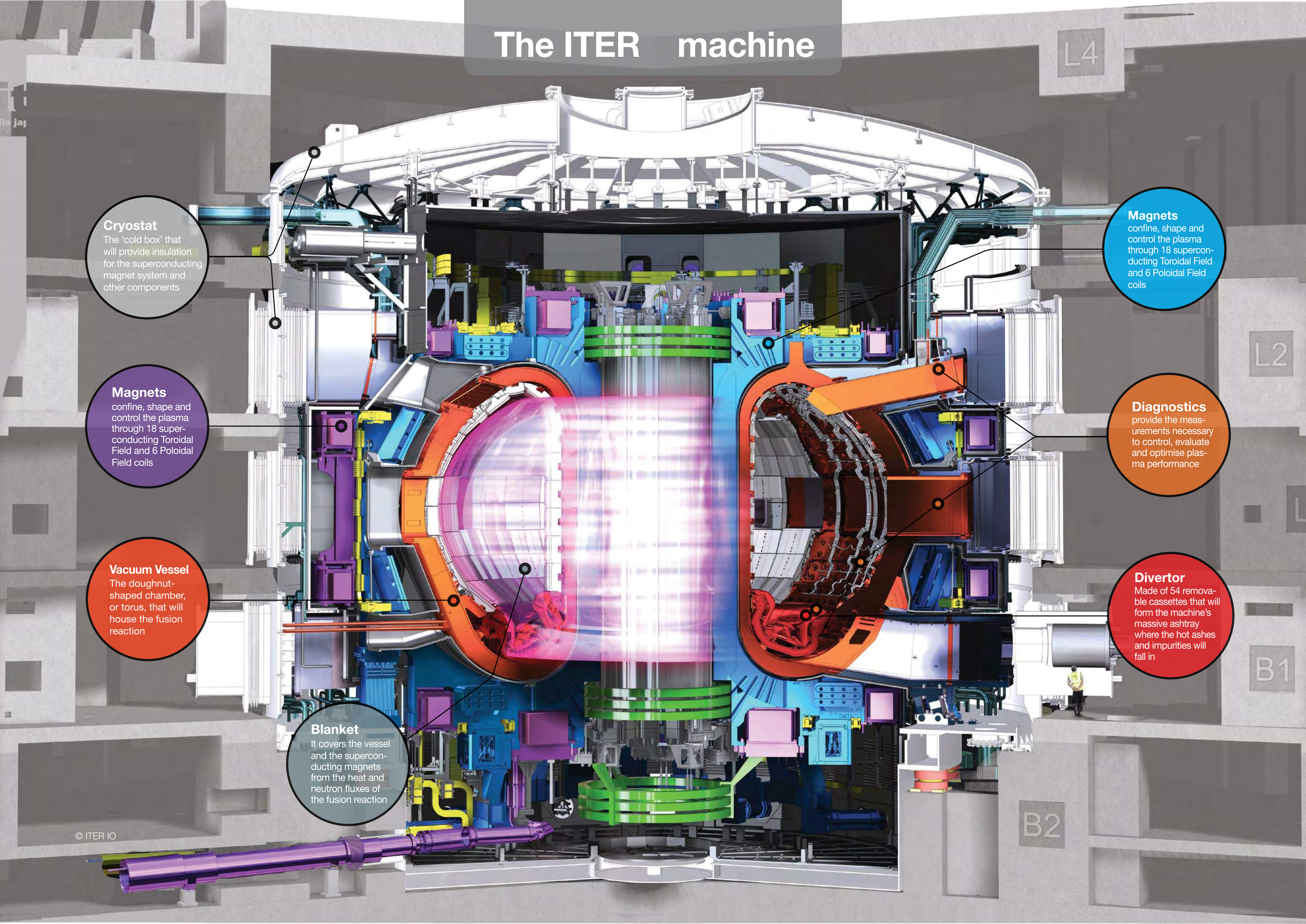
The second contract signed with Ferrovial covers all activities from design to construction of ITER's cold/hot basin and cooling water towers structure. In essence, 10 Olympic size swimming pools of 26 000m^3 will store the water that will travel in and out of the ITER machine in order to cool down its high temperatures. Additional buildings will be constructed to support the foundations of cooling water system pumps and pipes, water treatment and heat exchangers.

02

Manufacturing the ITER components

The biggest ever fusion device that will demonstrate the viability of fusion energy is relying on massive, complex and impressive high-tech components that have undergone rigorous manufacturing tests and are underpinned by extreme accuracy. Components of such size have never been manufactured before!

Europe's in-kind contribution to ITER amounts to roughly 50% of the total. Its share offers an unprecedented opportunity to industry, SMEs and fusion laboratories to get involved and contribute to the biggest international collaboration in the field of energy.


The ITER machine
Cryostat
The 'cold box' that will provide insulation for the superconducting magnet system and other components
Magnets
confine, shape and control the plasma through 18 superconducting Toroidal Field and 6 Poloidal Field coils
Vacuum Vessel
The doughnut-shaped chamber, or torus, that will house the fusion reaction
Blanket
It covers the vessel and the superconducting magnets from the heat and neutron fluxes of the fusion reaction
Magnets
confine, shape and control the plasma through 18 superconducting Toroidal Field and 6 Poloidal Field coils
Diagnostics
provide the measurements necessary to control, evaluate and optimise plasma performance
Divertor
Made of 54 removable cassettes that will form the machine's massive ashtray where the hot ashes and impurities will fall in
L4
L2
B1
B2
© ITER IO

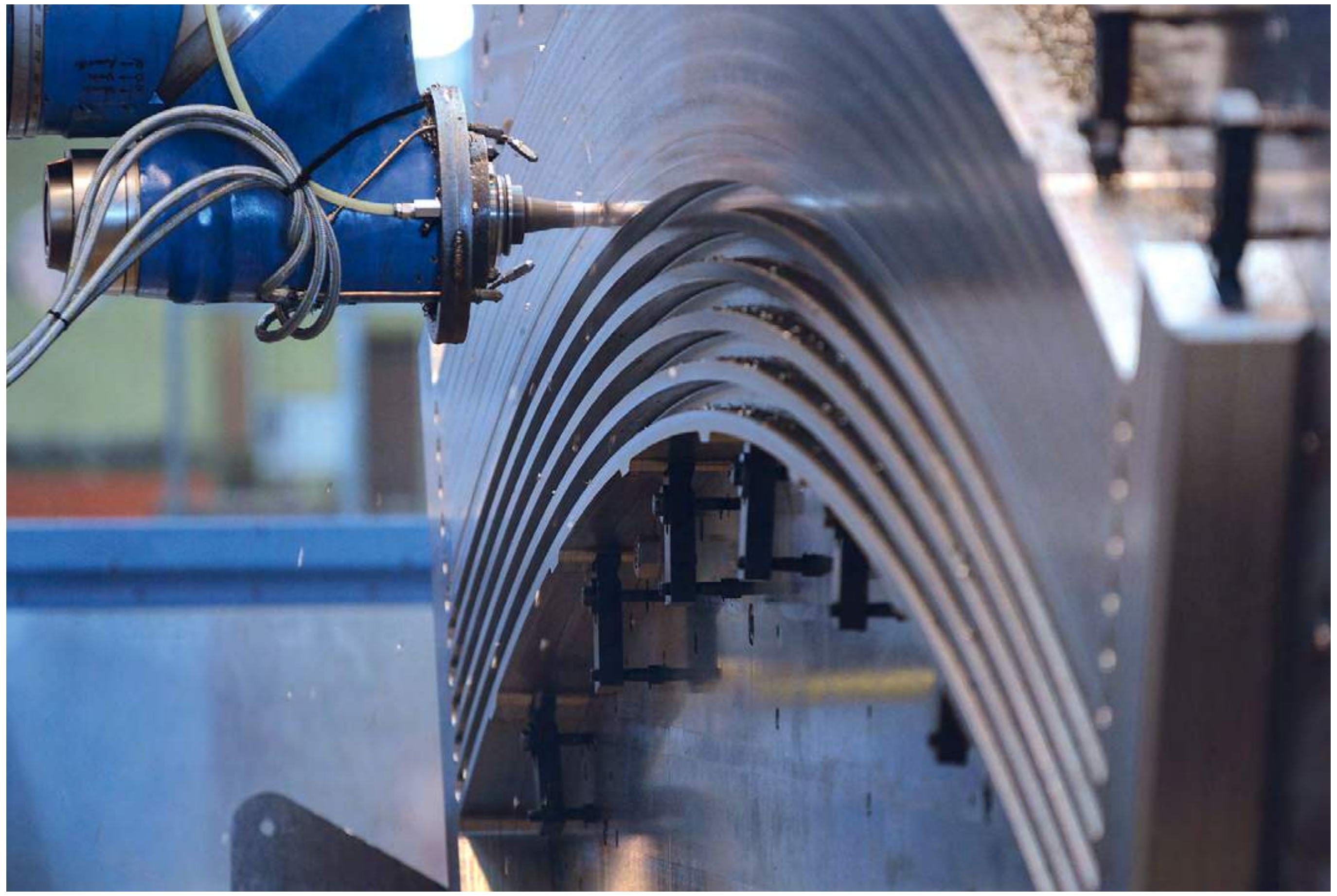
The production of the radial plates for the Toroidal Field coils has started

CNIM Industrial Systems and SIMIC S.p.A have started manufacturing the first of the 70 radial plates that will support the superconducting cables of ITER's Toroidal Field coils. The components will essentially confine the hot plasma with the help of powerful magnets. Each company will have to manufacture 35 radial plates that measure 14 m x 9 m.

CNIM's building at its Brégaillon industrial site has been renovated, and a brand new 3 000 m² production hall has been constructed close to the sea, to facilitate the transportation of large items that will be manufactured. The new building is fully air-conditioned to enable equipment to be kept at a constant temperature during its final machining. Inside the building, a 36 m x 9 m portal machining centre stands out "ready to machine two radial plates simultaneously to a precision of several tens of microns", as Jean-Claude Cercassi, CNIM Commercial Development Manager, explained. Work has been progressing fast at CNIM after the first batches of raw materials were delivered. The stainless steel segments have been machined and the electron beam welding will follow thanks to the installation of a dismountable vacuum chamber.

SIMIC S.p.A has also built a new industrial building in Porto Marghera to accommodate the production of the radial plate prototype, with brand new facilities and tooling, in order to support the production of the radial plates. A massive portal machine has been installed, which will operate in addition to the existing one that was used for the machining of the prototype, to manufacture the 35 radial plates. Marianna Ginola, commercial manager of SIMIC S.p.A, explained that "the manufacturing phase of the radial plates is the most exciting part of our contribution to the project. Our new building is ready, new tooling is in place. The production of the radial plates has started! The design has started taking shape and the impressive milling machine that SIMIC has invested into is put to operation. Our expertise will be fully deployed to deliver these key components".

The first radial plates were completed in July and were transported by sea to La Spezia, Italy, to be fitted inside the ITER Toroidal Field coils at a facility run by ASG Superconductors. After having produced a second radial plate five weeks later, CNIM and SIMIC S.p.A have accelerated production to a rate of one radial plate every four weeks.



Machining with high precision the grooves of the radial plates at CNIM

Overview of the SIMIC facility in Italy, Porto Marghera, while works of radial plate tilting are being carried out

Europe has signed its final contract for ITER Toroidal Field coils

A landmark multimillion contract has been signed between F4E and SIMIC S.p.A, an Italian company specialised in high-tech engineering and manufacturing, marking the successful completion of Europe's strategy in the domain of the Toroidal Field (TF) coils, part of ITER's impressive magnet system.

The Director of F4E, Professor Henrik Bindslev, explained that "thanks to this contract the last and most decisive chapter of the TF coils manufacturing is about to be written. We will produce magnets of unprecedented size and power following extremely complex techniques. This final procurement is a clear demonstration of Europe's commitment to the project and its capacity to be competitive and meet high technical standards".

For Marianna Ginola, Commercial Manager of SIMIC S.p.A "this is an impressive achievement that enhances the proven track record of our company and associates Italian manufacturing amongst the most skilled in the world. ITER has given us the opportunity to build international collaborations. In this contract for instance, we will collaborate with Babcock Noell Gmbh. This project has given us the possibility to access new markets and grow both in size and expertise".

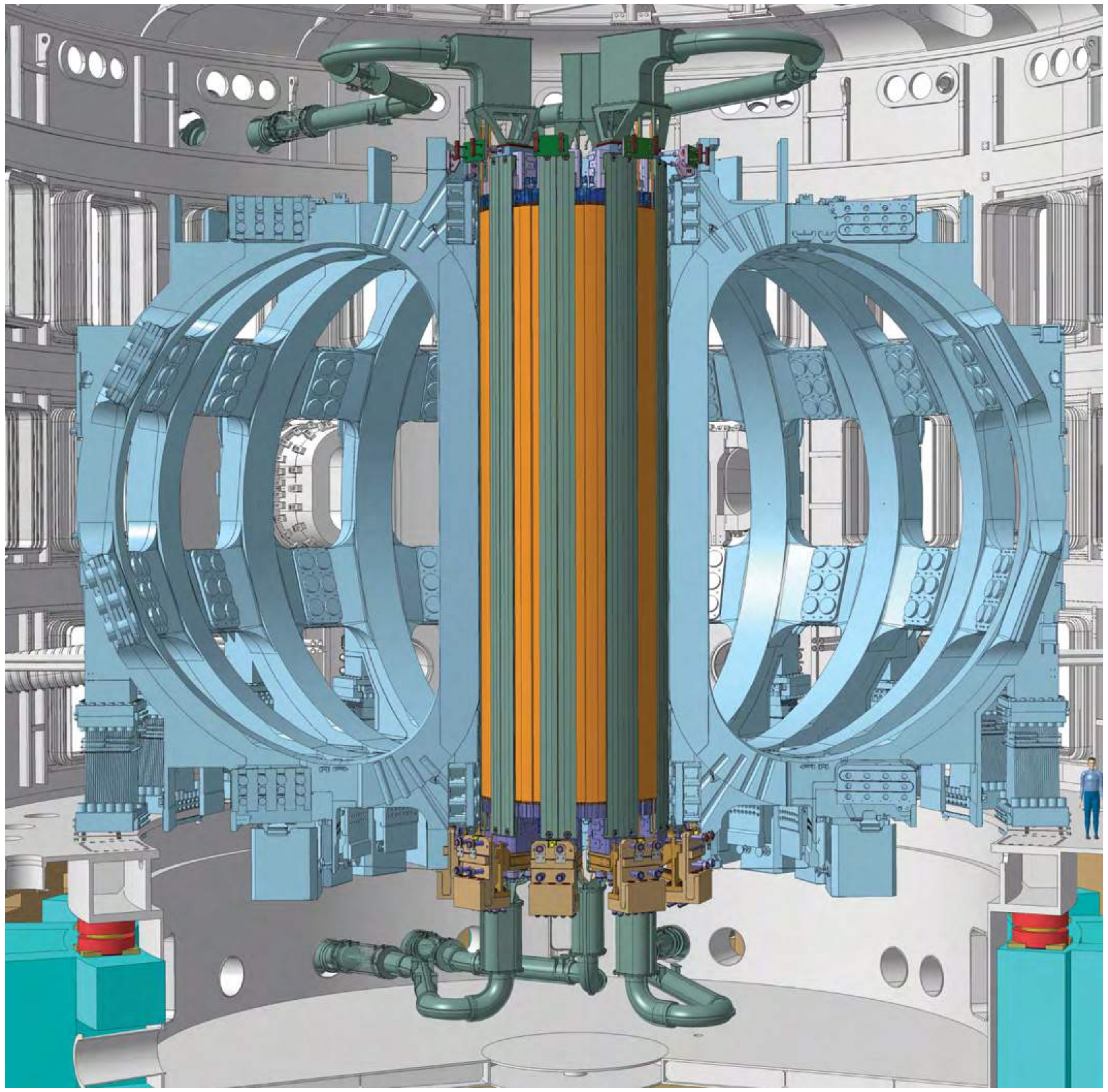
The contract is expected to run for approximately five years and its budget will exceed the amount of 100 million EUR. Through this contract, the TF coils will be tested at extremely low temperatures reaching nearly -200 ° C/80 Kelvin and subsequently will be inserted within their cases in order to be finally assembled in the ITER machine.

The scope of this contract

First, the winding packs will be cold tested at -200 degrees Celsius/80 K using a combined cycle of nitrogen and helium. Next, they will be inserted into the TF coil cases, which will require sophisticated laser dimensional controlled technology and complex tooling in order to move and fit hundreds of tonnes with millimetric precision.
Then, the cases will be welded in compliance with the stringent ISO standard 5817 in order to close the metallic structure. Two important characteristics will add to the complexity: the thickness of the weld which will reach 130mm and the fact that welding will have to be carried out only from one side. For these reasons, ultrasonic technology will be deployed to inspect the quality of welding.
The gap between the winding pack and the TF coil case will have to be filled with reinforced resin to mechanically link the components. The high density of the resin makes this task particularly challenging. Try and imagine filling a tight gap that is 4mm thick and 35m long with 1m³ of resin that has the thickness of honey.
ITER is a puzzle of many different interfaces that will need to be managed in a seamless way. Most TF coil components, like the winding packs and the radial plates are manufactured in Europe. The TF coil cases however, are manufactured in Japan while the thermal shields of the Vacuum Vessel that will be ultimately welded on the TF coils, in Korea. In other words, the multiple interfaces and their careful management will be fundamentally important for the successful execution of this contract.

"this is an impressive achievement that enhances the proven track record of our company and associates Italian manufacturing amongst the most skilled in the world. ITER has given us the opportunity to build international collaborations."

Marianna Ginola
Commercial Manager
SIMIC S.p.A



3D image of the ITER TF coils
© ITER IO

What is the role of TF coils and their specifications?

ITER will demonstrate the feasibility of fusion energy. The temperature of ITER's superhot plasma is expected to reach 150 million degrees Celsius. The challenge is to keep the plasma burning without touching the walls of the vessel of the reactor. The TF coils are "D" shaped gigantic superconducting magnets whose main task will be to create a magnetic cage where the plasma will be confined. Europe is responsible for the manufacturing of 10 out of the 18 TF coils of the machine.

Magnets of unprecedented size, weight, power and technique

The TF coils are composed of a winding pack and its stainless steel coil case. Each TF coil is 15m high, 9m wide and has a cross section of about 1m2. It weighs approximately 340 tonnes, which compares to six Boeing 737-800 planes! These will be the biggest Nb3Sn magnets ever manufactured, which once powered with 68000 A, they will generate a magnetic field that will reach 11.8 Tesla- about one million times stronger the magnetic fields of the earth.

The manufacturing of Toroidal Field coils in few steps

Welding operators inspecting laser welds on the Double Panckake prototype

01 Winding of the conductor

The conductor consists of roughly 1 000 Nb3Sn (niobium tin) and copper strands, cabled and twisted in a stainless steel conduit, about 47 mm in diameter and 2 mm thick. Winding tooling, numerically controlled synchronised equipment, will be used to bend the 750 m of cable-in-conduit conductor (CICC) in a D-shaped double-spiral trajectory to form one module, known as Double Pancake. The conductor must be bent with millimetric accuarcy.

02 Heat treating the conductor

Soon after the winding of the conductor is completed, groups of three double pancakes at a time will be heat treated in a massive oven to make them superconducting. The furnace is about 1.8 m high, 10 m wide and 16 m long. The heat treatment is carried out during one month and temperatures up to 650° C.

03 Inserting the conductor in the radial plate

With the help of insertion tooling we will transfer the heat treated conductor inside the radial plate, a metallic structure with grooves machined on both sides. The trajectory of the conductor and of the radial plate must match within fractions of millimetres. During this operation it is vital that the level of the conductor deformation is below 0.1%. Otherwise, the superconducting strands can get damaged and reduce the performance of the superconductor.

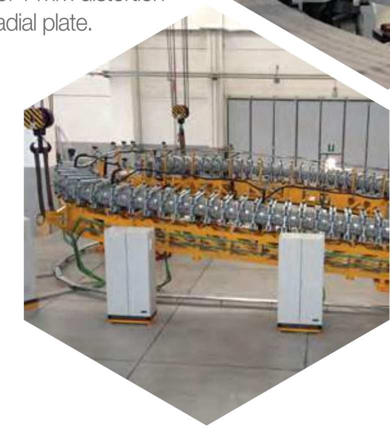
04 Wrapping and insulating the conductor

After the conductor is placed inside the grooves of the radial plate, we need to start wrapping the electrical insulation around it. The electrical insulation is composed of several layers of glass-kapton tape wrapped around the conductor. 12 trolleys run at a fixed distance along the trajectory of the conductor in order to lift the conductor, wrap the insulation around it and finally place it back inside the grooves of the radial plate.

05 Laser welding the radial plates

Once the conductor has been fully insulated, the cover plates of the radial plate will be assembled on top of the radial plate grooves and laser welded. For each radial plate a total length of 1.5 km needs to be welded. During the welding process, three robots are working simultaneously onto the radial plate. One of the main challenges is to minimise any deformation of the radial plate that will arise from the welding process. At the end of the welding process, a maximum of 1 mm distortion is allowed for the whole 13.4 m x 8.7 m radial plate.

06 Insulation and Impregnation



After the welding of the cover plates, several layers of ground insulation tape (glass and polyimide) are wrapped around the Double Pancake manually, in a way similar to the automated wrapping of the conductor. The module is then inserted into an impregnation mould. The impregnation process includes the following steps: injection of epoxy resin under vacuum to eliminate all air bubbles; pressurising the resin to penetrate in radial plate grooves; and finally curing of the resin at 155 °C.

Final inspection on the completed wire with an Eddy Current test station at Bruker EAS (courtesy of Bruker EAS GmbH)

Europe completes the production of its superconducting wire for the Toroidal Field coils

F4E in collaboration with Bruker European Advanced Superconductors and Oxford Superconducting Technology, concluded an important milestone linked to Europe's contribution to ITER's powerful magnets.

Due to their size and complex technical specifications, an outstanding production of Nb_3Sn (Niobium-Tin) superconducting wire was recorded exceeding all the typical annual rates of production before ITER came to play.

The wire is the key component that will allow the Toroidal Field coils to reach the impressive magnetic field of 12 T required for the plasma to be confined in the ITER machine. Its diameter is less than 1 mm and can sustain very high currents around 200 A when cooled down to low temperatures at -269 °C. Altogether 97 tonnes of the superconducting wire have been produced, tested, approved by F4E and cleared by ITER International Organization.

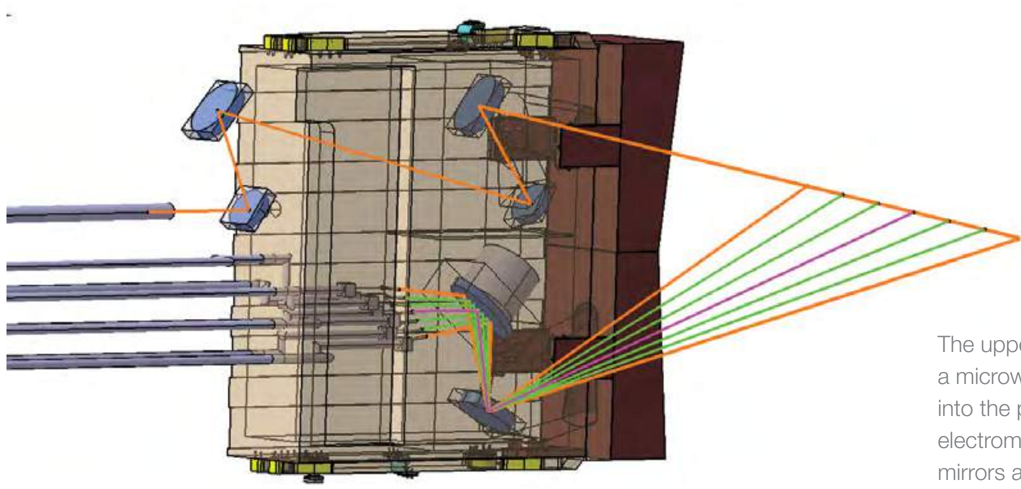
The amount of wire manufactured by the two companies includes more than 1 500 production units, used to fabricate the cables for the European TF coil cable-in conduit conductor lengths. The total wire length produced exceeds 20 000 km which is around half of the earth's circumference.

This wire is already used in the manufacturing of the European TF conductors for which around 50% of the lengths have been already fabricated and delivered to ASG facilities in Italy where the works for the TF coil winding packs are being carried out. The production of the remaining European TF conductor lengths will be completed in 2015.

80 000 km
of niobium-tin (Nb_3Sn) superconducting wires are used for ITER's magnets - this is long enough to wrap twice around the earth.

Danish and Portuguese fusion laboratories to design diagnostic system for ITER

F4E and a consortium comprising the Danish and Portuguese Research Units (DTU and IST-IPFN) have signed a Framework Partnership Agreement (FPA) for the development and design of the Collective Thomson Scattering (CTS) diagnostic system for ITER. The contract will run for the next four years.



The upper antenna and mirrors will launch a microwave beam (1 MW at 60 GHz) into the plasma and records the scattered electromagnetic waves through the lower mirrors and receiver antennas.

The CTS diagnostic system will monitor in seven locations how the speed of fast ions will evolve within the ITER plasma. Fast ions are elusive particles which are a natural consequence of the fusion process and plasma heating techniques. Although they represent less than five per cent of the plasma density, they carry up to one-third of the plasma's kinetic energy. Optimising their confinement within the plasma is important as they play a major part in sustaining the high plasma temperatures required for the fusion reaction as they collide with and transfer their energy to 'bulk' particles in the plasma. However, fast ions are somewhat problematic as they behave unpredictably: some remain in the magnetic field, others escape the plasma and reduce confinement, or amplify plasma disturbances.

Confined fast ions have previously eluded experimental observation as traditional laser diagnostic techniques have not been able to capture these heavier ions. The CTS diagnostic system involves a different approach as rather than focusing on the individual particle, measurements focus on the collective motion of the whole group. CTS takes advantage of the fact that fast ions leave a wake as they travel through a cloud of electrons. Although the ions are nearly impossible to monitor, their wakes are detected through the CTS technology.

The CTS diagnostic system will consist of mirrors and antennas integrated in the Equatorial Port Plug 12 of the ITER machine. The upper antenna and mirrors will launch a powerful, single and high frequency microwave beam (1 MW at 60 GHz, equivalent to 1 000 microwave ovens at full power) into the plasma and records the scattered electromagnetic waves through the lower mirrors and receiver antennas. The measurement enables establishing the dynamics and distribution of the ions in the plasma – especially the fast ions from the fusion processes.

F4E collaboration with IDOM on high-tech ITER systems

A multimillion contract for engineering integration of many state of the art instruments that will measure the biggest plasma generated by a fusion device has been signed between F4E and IDOM ADA, the Advanced Design and Analysis division of IDOM, a multinational company specialising in engineering, architecture and consultancy services based in Spain.

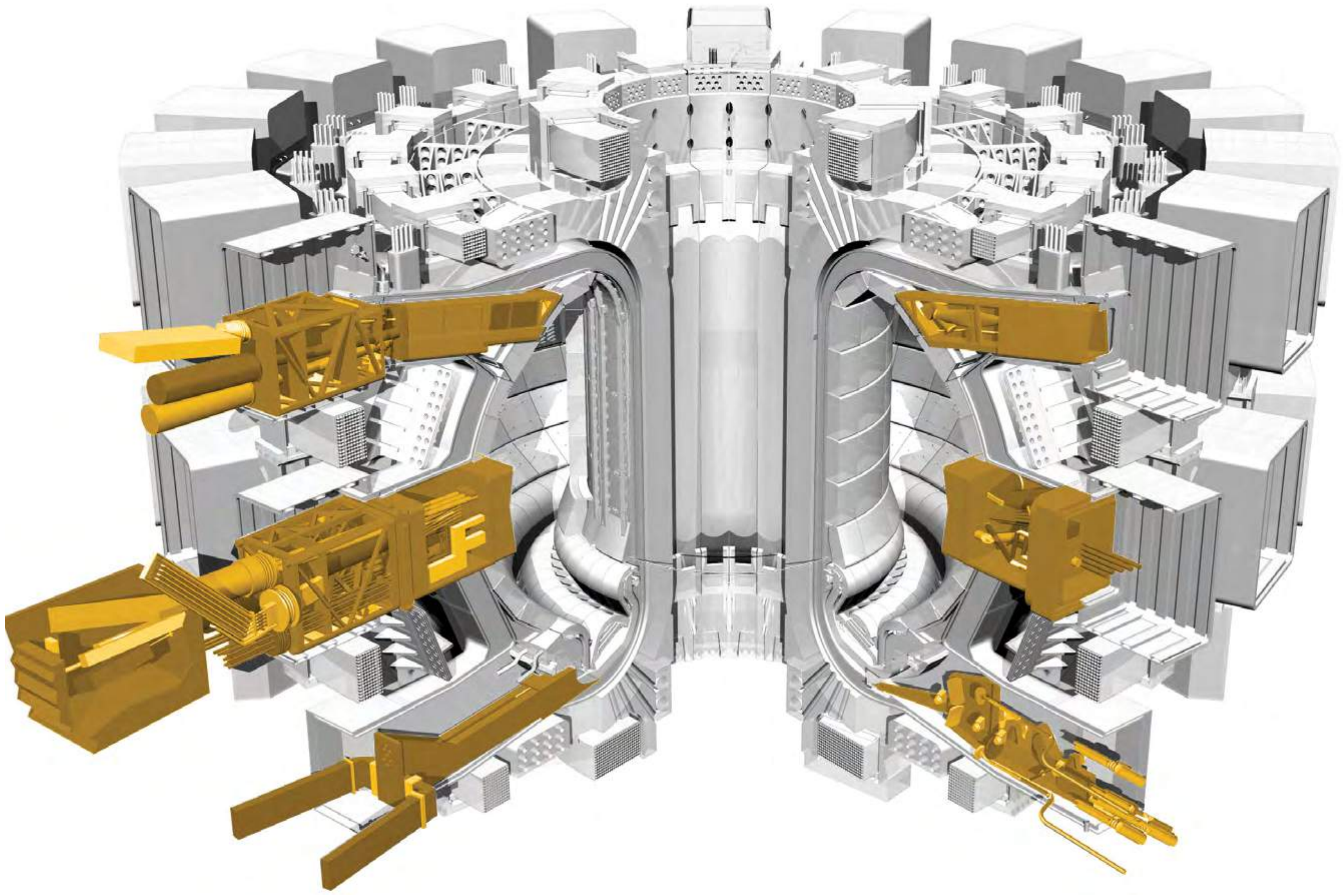
"We are very proud of the opportunity that we have been given to collaborate in what most likely will be the most important research project of the XXI century in the field of energy and engineering."

Fernando Querejeta
President of IDOM

The value of the contract is in the range of 20 million EUR and is expected to run for at least four years. IDOM ADA will work with instrument designers in several public European fusion laboratories as well as experts in Japan, India, China and the US to deliver designs for the systems integration. A new chapter in the field of Diagnostics has started that will help us analyse the ITER plasma, monitor it and improve our understanding of physics. Mr. Fernando Querejeta, President of IDOM, has stated that "we are very proud of the opportunity that we have been given to collaborate in what most likely will be the most important research project of the XXI century in the field of energy and engineering. This contract is another big step in our already important activity as science system providers for large scientific installations and instruments".

The scope of this contract
This contract will deliver a comprehensive engineering design integrating around 20 diagnostics instruments into five of the ports giving access to the ITER plasma. In-vessel metallic containers will also be designed through this contract in order to protect the diagnostic equipment from the fierce plasma temperatures that may reach 150 million °C, and shield other parts of the machine from neutron radiation.

The metallic shields will weigh between 5 tonnes and 20 tonnes each and will have to cope with extreme conditions like the high vacuum, colossal electromagnetic forces and high heat fluxes. In addition, other structures will be designed to house diagnostic instruments that will be mounted onto the Divertors cassettes of the machine, and even outside the vacuum vessel, as well as specialist flanges providing water and electrical connections to the diagnostic instruments whilst preserving the ITER vacuum.



The ITER ports will house the instruments that will control, evaluate and optimise ITER's plasma performance. These include measurements of temperature, density, impurity concentration.(© ITER IO)

The role of Diagnostics in ITER

The Diagnostics system will help us understand what exactly will be happening in the machine during the fusion reaction. Thanks to this system we will able to study and control the plasma behaviour, measure its properties and extend our understanding of plasma physics. In simple terms, the system will act as the eyes and ears of the scientists offering them insight thanks to a vast range of cutting edge technologies. ITER will rely on approximately 50 diagnostic instruments that will offer experts an unparalleled view of the entire plasma and ensure the smooth operation of the machine. Given the duration of the plasma pulse, which will be 100 times longer than any fusion device currently in operation, the strong fluctuation levels and the extreme environment in the vessel, the diagnostic system will act as the guardian of the safe and sound operation of ITER.

Europe is responsible for roughly 25 % of all Diagnostics in ITER.

Europe to equip the biggest cryoplant in the world

A major technological deal has been reached between Fusion for Energy and Air Liquide, gas technology global leader, in order to equip the world's biggest cryoplant that will cool down the ITER machine to temperatures as low as -269 ˚C.

From left to right: Professor Henrik Bindslev, F4E Director, and Mr Benoit Hilbert, Director General of Air Liquide Engineering

The works will be completed in five years and the budget foreseen is in the range of 65 million EUR. The contract covers the engineering, procurement, installation and testing of the facility and auxiliary systems.

Professor Henrik Bindslev, Director of F4E, explained that "thanks to ITER, the frontiers of science and technology are pushed further and Europe's industry will become more competitive". Cristiano Tortelli, Vice-President, Global Air Liquide E&C Solutions, commented: "Our participation to ITER is driven by technological innovation, underpinned by the recognition of our expertise and in line with our commitment to invest in tomorrow's energy mix."

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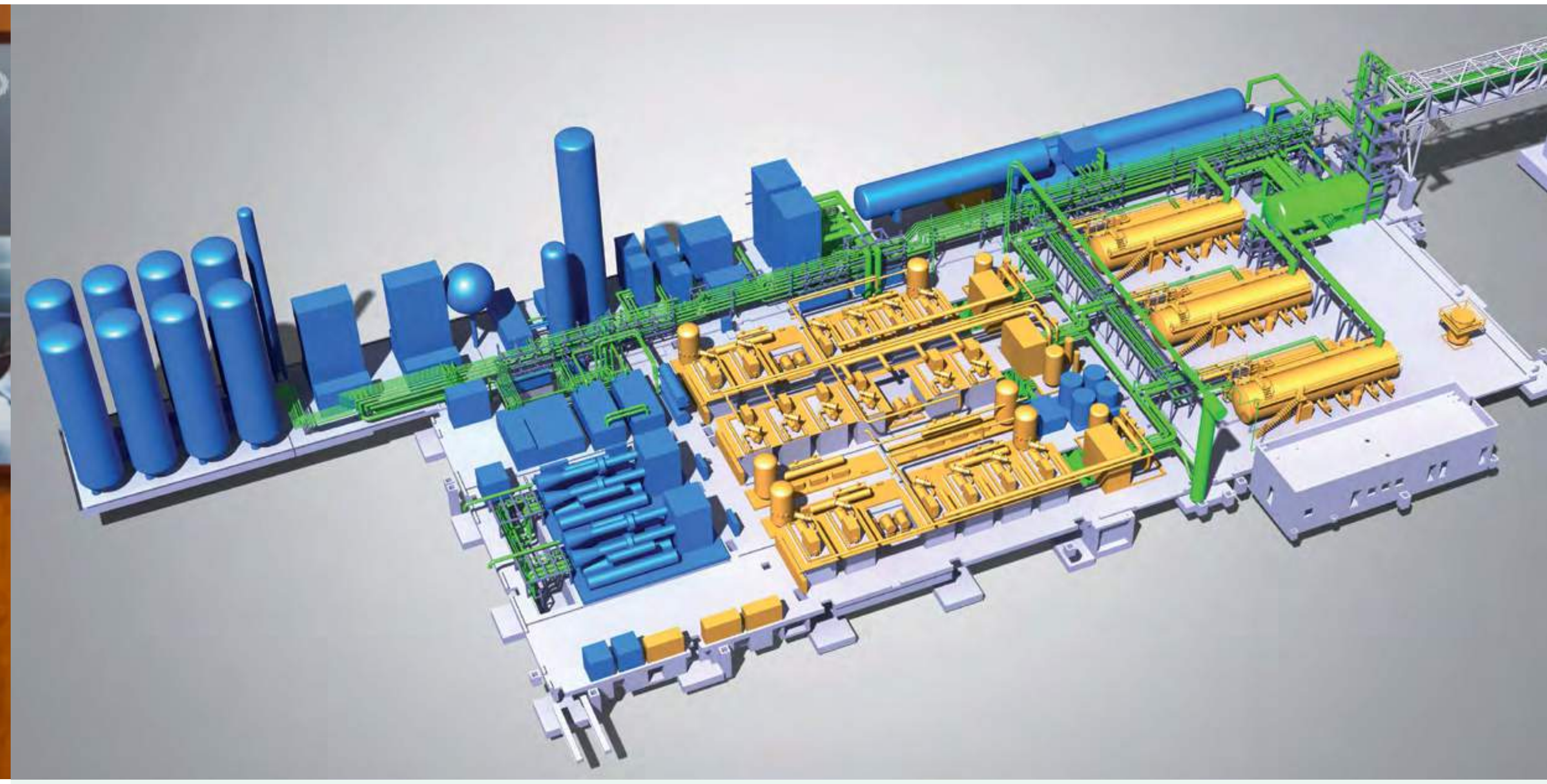


The ITER cryogenic facilities. Within the 5 400 m² Cryoplant Building, more than 3 000 m² are reserved for the three identical LHe plants that will work in parallel to provide ITER's superconducting magnets and cryosorption panels with the cold environment they need. ITER IO.

What is the function of the cryoplant?
Think of the cryoplant as ITER's massive fridge that will produce and distribute the cooling temperatures in the machine through different networks. The most advanced cryogenic technologies will be deployed to generate extremely low temperatures needed for the ITER magnets, thermal shields and cryopumps. For example, the magnets will be cooled with super critical helium to reach a superconducting state at 4.5 K, close to absolute zero, in order to confine the hot plasma.

What is the European contribution to ITER's cryoplant?
Europe will provide the Liquid Nitrogen Plant and auxiliary systems that will cool down, process, store, transfer and recover the cryogenic fluids of the machine. Two nitrogen refrigerators will be manufactured along with two 80 K helium loop boxes, warm and cold helium storage tanks, dryers, heaters and the helium purification system. The high performance requirements will be underpinned by high safety standards and a sophisticated operational system.

Ion Source and Extraction Power Supplies (ISEPS) for the SPIDER experiment have passed successfully factory acceptance tests

OCEM Energy Technology and Himmelwerk GmbH, have invited representatives from F4E, ITER International Organization and the Italian European Fusion Laboratory RFX, to witness the successful outcome of the final factory acceptance tests before the full first unit of Ion Source and Extraction Power Supplies (ISEPS) for the SPIDER experiment is delivered.

The participants of the ISEPS Factory Acceptance Tests standing in front of the equipment (Image courtesy of OCEM)

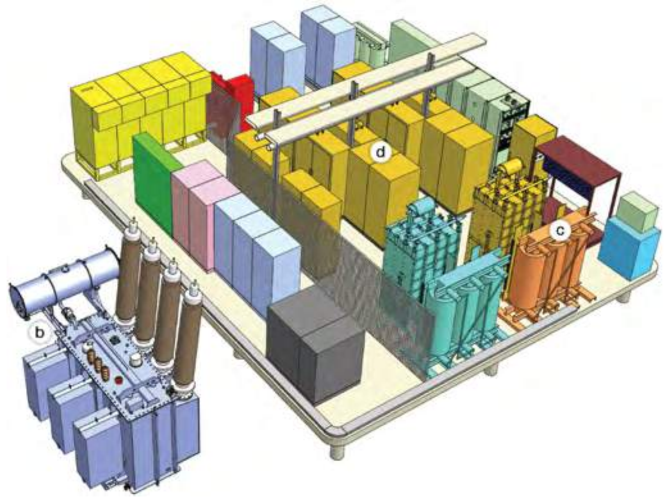
SPIDER (Source for Production of Ion of Deuterium Extracted from Radio frequency plasma) is one of the test beds of the Neutral Beam Test Facility which is dedicated to the testing and development of the ITER Neutral Beam injectors in Padua, Italy.

The two Neutral Beam injectors are among the main F4E contributions to the additional heating systems that ITER will use. Their purpose is to supply 16.5 MW of power each to inject high-energy beams of neutral atoms into the core of the ITER plasma and provide the high temperature necessary for fusion reactions to occur in the plasma. The neutral beam is obtained by creating a beam of negatively charged ions, then accelerating it to high speeds and finally neutralising it through an interaction with neutral gas of the same type. Any non-neutralised atoms are removed from the beam through an electrostatic field. The Neutral Beam injectors are unique in terms of high energy (1 MeV), pulse duration (up to 3 600 s) and power. Therefore, they need to be tested before being installed in ITER. SPIDER will host the first full-scale ITER ion source which will be tested and developed with an acceleration voltage of up to 100 kV.

The Ion Source and Extraction Power Supplies (ISEPS) include all the power supplies required for feeding the ion source of the Neutral Beam injector and for extracting an ion beam from the source, through the use of four radio frequency generators. The final factory acceptance tests were followed by power tests of the whole system connected to one of the four radio frequency generators supplied by subcontractor Himmelwerk GmbH.

Tullio Bonicelli, F4E's Project Manager Neutral Beam and EC Power Supplies and Sources, explained that "OCEM Energy Technology have proven to be highly skilled collaborators and have shown great adaptability in terms of the demanding specifications for ISEPS. The expertise of German SME Himmelwerk GmbH has been very useful thanks to the company's proven expertise in radio-frequency generators. Likewise, the RFX team has provided vital support to F4E in the technical monitoring of this key contract for the overall procurement of SPIDER power supplies".

In total, the procurement contract signed between F4E and OCEM Energy Technology has encompassed four almost identical ISEPS units to be delivered, two of which will be used for the Neutral Beam Test Facility. The remaining two units will cover the needs of the two ITER Neutral Beam injectors on the ITER site.



a. The ISEPS power supplies are hosted on a 12 x 10 m insulated platform. They are fed and insulated at -100kV from ground via an insulating transformer (22kV/6.6kV, 5MVA) located outdoors, (Image courtesy of OCEM).

b. Insulating transformer (Image courtesy of OCEM)

c. Power supply feeding in the direct current (DC) the 4 radio frequency generators (1.6MW)

d. The radio frequency oscillators hosted in these cubicles generate high frequency (1MHz) energy used by the source to produce the plasma from which negative ions are then extracted (Image courtesy of OCEM.

SME has been entrusted to heat up ITER's plasma

Ampegon AG will manufacture, install and commission the power supplies for the Electron Cyclotron system, one of ITER's heating systems, that will make its hot plasma reach 150 million ˚C.

The company has made history being Switzerland's first-ever SME to contribute to the prestigious fusion energy project, demonstrating that SMEs have a role to play to the most ambitious international collaboration in the field of energy. Josef Troxler, Ampegon CEO, explained that "the power supplies are a critical element of the machine. We are proud to offer our expertise and be amongst the companies that will build the world's largest fusion project".

The role of the Electron Cyclotron as part of ITER's external heating systems:
The electron cyclotron is one of the heating systems that will be used to achieve the fusion reaction at a temperature which is roughly ten times the one in the core of the sun. It will operate like a powerful microwave oven. High frequency electromagnetic waves will transfer their energy to the plasma, raise its overall temperature and drive additional current to sustain longer discharges. The precision of the electron cyclotron will help scientists to target specific plasma areas that require an extra blast of heat and maintain plasma confinement and stability.

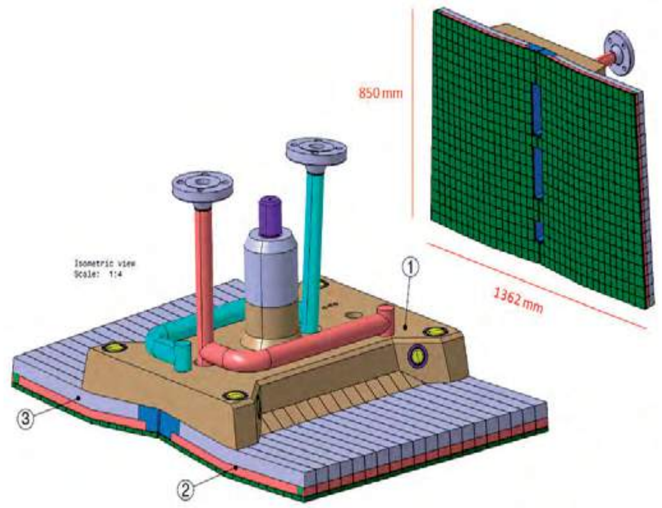
During the next six years, Ampegon AG will work to deliver 8 out of the ITER's 12 main high voltage power supplies (55kV/100A) and 16 body power supplies (35kV/100mA). The main task of power supplies will be to transform the electricity from the grid to regulated direct current and voltage that ITER will need to generate the electromagnetic waves. The power supplies system will be designed to shut down in less than 10 micro-seconds.

Ampegon's Michael Bader, Head of RF and Power Electronics, and his team fine tune high voltage power supply equipment.

Contracts for the full-scale prototype of ITER Blanket First Wall have been signed

Three different entities, namely Atmostat (ALCEN group, France), AREVA (France) and a consortium which consists of AMEC (United Kingdom), Iberdrola (Spain) and MIB (Spain) have been asked to manufacture the first full-scale prototypes of the First Wall, that acts like a blanket protecting the vacuum vessel from the neutrons and other energetic particles that are produced by the hot plasma.

The First Wall consists of 440 panels, of which F4E will provide about half and depending on the location of the modules in the Blanket, different design parameters are necessary. During operation, the ITER First Wall panels will be cooled by pressurised water. Given the technically-challenging nature of the project and the need to maintain competition and contain risks until the series production, F4E has opted for a strategy of different suppliers. Each of these companies will have to manufacture a prototype of a Blanket First-Wall panel, as well as to carry out specific industrialisation studies for the fabrication of the series of the 215 panels and present a cost and schedule assessment.



The ITER First Wall will consist of 440 panels, each of which will be fixed on a shield block in order to form the Blanket modules. The Blanket will protect the vacuum vessel from neutrons and other energetic particles that are produced by the hot plasma.

F4E and Assystem have started working on the remote handling system for the ITER divertor

ITER's high tech remote handling system has entered its most decisive phase so far thanks to a multimillion deal signed between F4E and Assystem, a leader in innovation and engineering consultancy.

All activities ranging from design, manufacturing, delivery, on-site integration, commissioning and final acceptance tests for ITER's divertor will be covered through this contract as it unfolds progressively. Its value is estimated in the range of 40 million EUR and it will involve some of the pioneers from the area of remote handling in Europe such as the UK's Culham Centre for Fusion Energy (CCFE) and Soil Machine Dynamics Ltd (SMD) together with Finland's Technical Research Centre (VTT) and the Tampere University of Technology (TUT). Through this contract, two multifunctional movers and two toroidal movers will be manufactured.

Thanks to this contract we have managed to bring together industry, fusion laboratories, SMEs and research centres under one partnership that will unleash their potential and help them advance further in their domain. Commenting on the award, Peter Higton, Assystem's Energy and Nuclear UK Managing Director who has led the team effort, said: "We are very pleased to have been selected for this prestigious project. This contract is recognition that our capabilities and reputation for delivering high standards of innovative engineering, quality and safety are valued by our customers. We look forward to working with F4E and our partners to deliver these high tech components".

What is remote handling?

Remote handling helps us to perform manually a task without being physically present at the location it is being carried out. It is widely used in space exploration missions, underwater or ground operations. The system brings together high-tech robotics, advanced technological tools, powerful computers and virtual reality platforms. A high level of intuition and intelligence are inbuilt within the system which is handled by a human operator with extreme dexterity because of the degree of millimetric precision that is required.

Why ITER needs a remote handling system for the divertor?

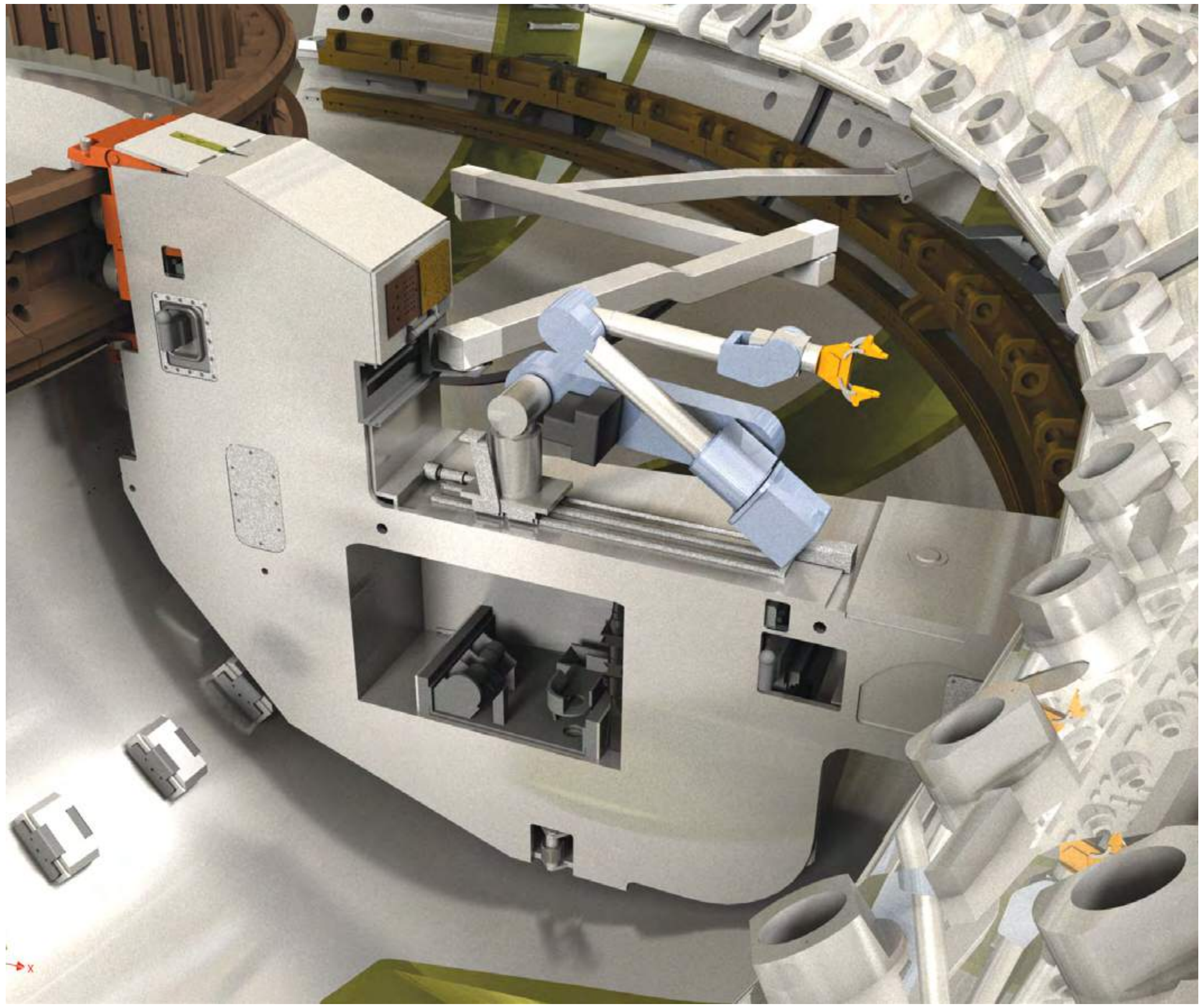
When the ITER machine is operational some of the components in the vessel will be exposed to radioactivity. Therefore, any maintenance, inspection and repair will be conducted through remote handling. The ITER divertor, located in the lower part of the ITER machine, will consist of 54 divertor casettes measuring 3.4 m x 1.2 m x 0.6 m and weighing 10 tonnes each. It is in this part of the machine that the superhot plasma temperature will be most felt. The divertor casettes will form the machine's massive ashtray where the hot ashes and impurities will be diverted to. It is foreseen that these components will be replaced three times during the lifetime of the ITER machine.

How will the ITER divertor remote handling work?

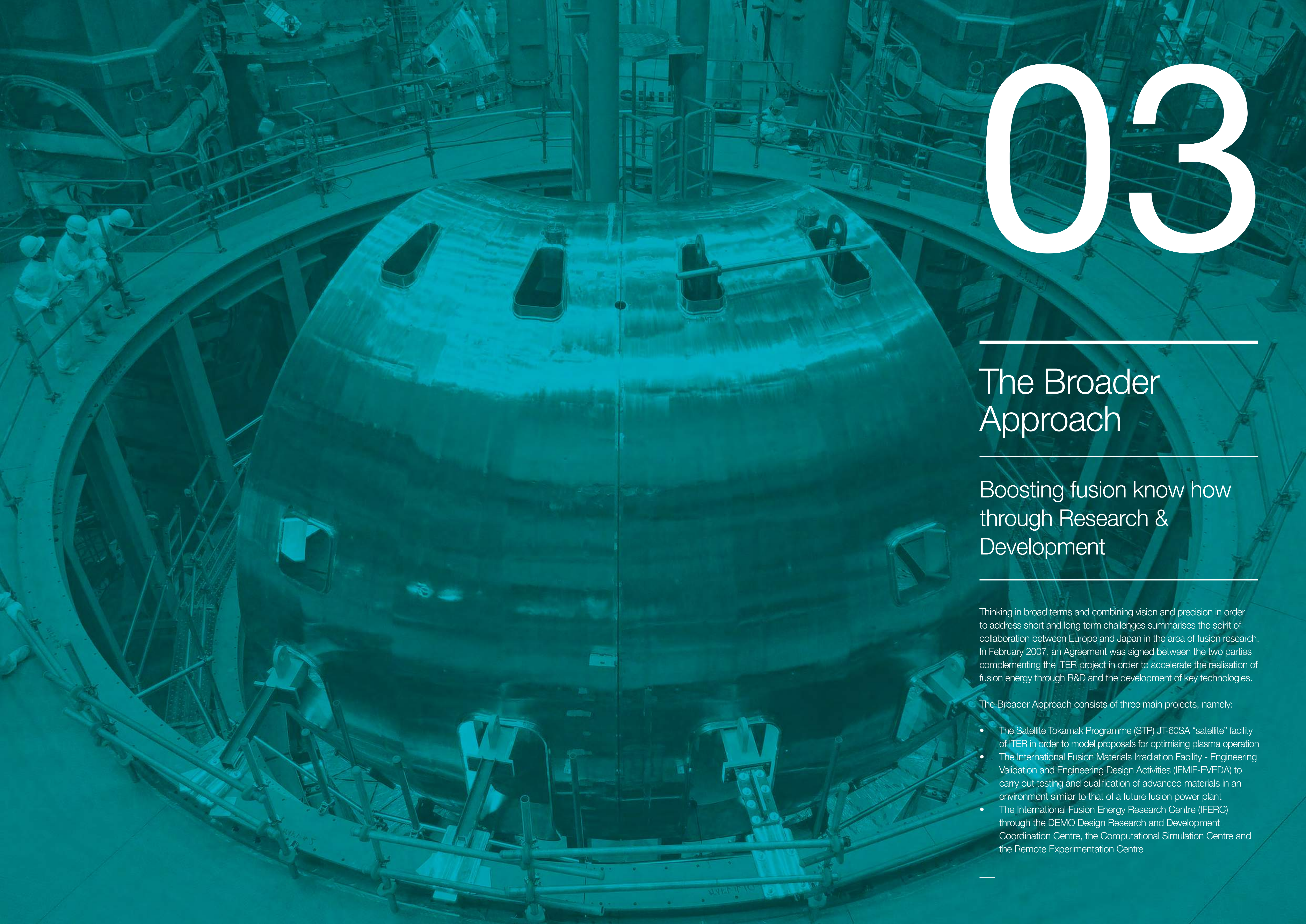
The 54 divertor cassettes will be installed by movers through three entry points, known as ports. If they need to be removed, they will be detached, unlocked from the ITER vessel, placed into a container and get transported.

"This contract is recognition that our capabilities and reputation for delivering high standards of innovative engineering, quality and safety are valued by our customers. We look forward to working with F4E and our partners to deliver these high tech components"

Peter Higton
Energy and Nuclear UK Managing Director
Assystem



3D image of the remote handling system for ITER divertor – photo credit: Assystem



03

The Broader Approach

Boosting fusion know how through Research & Development

Thinking in broad terms and combining vision and precision in order to address short and long term challenges summarises the spirit of collaboration between Europe and Japan in the area of fusion research. In February 2007, an Agreement was signed between the two parties complementing the ITER project in order to accelerate the realisation of fusion energy through R&D and the development of key technologies.

The Broader Approach consists of three main projects, namely:

- The Satellite Tokamak Programme (STP) JT-60SA “satellite” facility of ITER in order to model proposals for optimising plasma operation
- The International Fusion Materials Irradiation Facility - Engineering Validation and Engineering Design Activities (IFMIF-EVEDA) to carry out testing and qualification of advanced materials in an environment similar to that of a future fusion power plant
- The International Fusion Energy Research Centre (IFERC) through the DEMO Design Research and Development Coordination Centre, the Computational Simulation Centre and the Remote Experimentation Centre

First plasma and ion beam extraction have been achieved at the Linear IFMIF Prototype Accelerator

The International Fusion Materials Irradiation Facility (IFMIF) is one of the projects stemming from the Broader Approach Agreement (BA), a partnership in fusion energy research between Europe and Japan. IFMIF is an accelerator-based neutron source that produces, using deuterium-lithium nuclear reactions, a large neutron flux similar to that expected at the first wall of a fusion reactor.

The IFMIF/ EVEDA team of colleagues behind this very important milestone

Low Energy Beam Transfer installed in Rokkasho, Japan

Two important milestones have been achieved at the Linear IFMIF Prototype Accelerator (LIPAc): the accomplishment of the first hydrogen plasma in the ionisation chamber and the first extraction of an ion beam (H+).

In the case of LIPAC, the Japanese Atomic Energy Agency (JAEA) has been responsible for the procurement of the conventional systems, such as the accelerator building, the secondary cooling system, and the machine and personnel protection system. Europe's contribution, coordinated by F4E, has been delivered by the European countries voluntarily contributing to the BA. The LIPAC injector has been developed and manufactured by France's Commissariat à l'Énergie Atomique et aux Énergies Alternatives (CEA) Saclay. It has been successfully installed in Rokkasho, Japan, and has been under commissioning.

The achievement of the first plasma and beam extraction have been an important achievement for the LIPAc team, including participating experts from France's CEA, led by Raphael Gobin. After the accomplishment of the widely anticipated first plasma, extensively reported in Japanese media, within only two days, further commissioning allowed a proton beam of 100 keV and 100 mA to be obtained. The prospects are now excellent to reach the target of extracting a current of 140 mA of 100 keV D+ ions in the forthcoming commissioning phase with deuterium.

Supercomputer bullx® series. © Bull

Helios supercomputer has been upgraded to help fusion scientists with complex plasma codes

The International Fusion Energy Research Centre (IFERC), hosted by the Japanese Atomic Energy Authority (JAEA), is the home of one of the world's most powerful supercomputers known as "Helios". It is one of Europe's key contributions to the Broader Approach (BA) promoting R&D activities in the field of nuclear fusion and during the last three years, scientists have been given the opportunity to use the machine in order to perform complex calculations in plasma physics.

The machine manufactured by Bull has been further upgraded delivering 400 additional Teraflops to the 1555 Teraflops already installed making it even more powerful. The supercomputer has been provided in 2012 by France as a part of its voluntary contribution to the BA, through a contract between the Commissariat à l'Energie Atomique et aux Energies Alternatives (CEA) and Bull.

The supercomputer contains more than 70000 CPU cores linked together with a very fast interconnection network. With a memory exceeding 280 TB and high speed storage system exceeding 5 PB, it is complemented by a medium term storage system and a pre/post-processing and visualization system. Its memory is large enough to host a meaningful simulation of ITER. With the recent upgrade the number of Central Processing Unit cores has increased to 72 000 and anew partition based on 360 Intel xeon-phi co-processors was added.

The fourth call for submission of proposals was launched in November 2014 and the rate of oversubscription in the range of 300% has injected further competition amongst those who wish to apply.

Advanced training sessions, webinars and workshops have been organised both in Europe and Japan to help potential users learn how to modernise their codes and make memory access to the supercomputer as regular as possible. Currently, about 300 users are using Helios.

The supercomputer has been ranked 38th in the November 2014 list of TOP-500 for the main partition.

04

Working together with stakeholders

In order to better serve the various communities that have a vested interest in the ITER project, we have developed different platforms to listen, understand and respond to their needs.
F4E explored together with the different committees and the network of ITER Industrial Liaison Officers (ILOs) and European Fusion Laboratories Officers (EFLOs) a series of measures that would stimulate further the participation of industry, SMEs and R&D organisations.

F4E European Fusion Laboratory contact points and Industrial Liaison Officers have gathered together for the first time

F4E has been making a concerted effort to develop and strengthen its relationship with the European Fusion Laboratories (EFLs) who possess much of the expertise needed to build some of the systems being provided by Europe to the ITER project.

F4E has been making a concerted effort to develop and strengthen its relationship with the European Fusion Laboratories (EFLs) who possess much of the expertise needed to build some of the systems being provided by Europe to the ITER project. To this end, a European Fusion Laboratory Liaison Officers (EFLOs) Network has been created and its representatives have gathered for the first time during a combined meeting with the F4E Industrial Liaison Officers (ILOs) at the F4E offices in June.

The F4E Director has provided a comprehensive report on the progress of the ITER work and main highlights since the beginning of 2014. Activities and further ideas to strengthen the partnership between F4E and the EFLs were also presented. The main actions which F4E has put in place aim to simplify and increase flexibility in grant management, improve interaction between EFLs and F4E, and use EFL expertise. EFLOs have been encouraged to raise issues of concern in their relation with F4E and put forward proposals to strengthen the partnership.

An information session on the strategy and status of implementation of the work related to the area of diagnostics, an area within F4E which is strongly linked to EFLs, has been held. Sessions on ITER safety and Quality Assurance requirements, as well as lump sum grants, have also taken place.

“ Thanks to ITER and our leadership in fusion magnet technology we see new possibilities of growth in the energy sector ”

Stefano Pittaluga
ASG Superconductors

“ The benefit of working with F4E is to use the technology developed in recent years for the benefit of ITER ”

Sibylle Günter
Max-Plank-Institut für Plasmaphysik (IPP)

“ We are an SME…we are small but this kind of project helps us to think big ”

Guiseppe Tadia
OCEM

“ Thanks to ITER we managed to grow as a company and improve both on project management and technical aspects ”

Andres Felipe
Iberdrola Engineering and Construction

Safety marked as a top priority for ITER

The seven parties participating in the ITER project are determined to demonstrate the viability of fusion energy in compliance with demanding nuclear safety regulation. This strong commitment has brought together more than 100 specialists between 29-30 January, from F4E and ITER International Organization, to discuss the current state of play, draw lessons from previous projects and highlight good practice that will be of great value to ITER.

The event was structured along plenary and thematic sessions, giving the opportunity to different teams to discuss the latest French and International nuclear regulation applying to the manufacturing of ITER components. Carlos Alejaldre, ITER IO Deputy Director General and Director of the Department for Safety, Quality and Security (SQS), and Joelle Elbez-Uzan, ITER IO Head of the Nuclear Safety, Licensing and Environmental Protection Division, commented on the importance of events like this which unite all actors around a theme which is of significant importance. Jean-Marc Filhol, F4E Head of ITER Department, explained that it is imperative to instil a rigorous nuclear safety culture and encouraged all participants to learn from the valuable observations made by the French Safety Authority (ASN), linked to the inspections on the ITER construction site and the manufacturing facilities.

Experts during the plenary session of the Nuclear Safety meeting

F4E met with Fusion Industry Innovation Forum

Reaching out to key stakeholders is one of F4E's key objectives. "We ought to listen, understand and evaluate the different views regarding Europe's contribution to ITER, and the challenging path to DEMO, in order to ensure that our industry and innovation hubs are on board" explained F4E's Director, Professor Henrik Bindslev, in his opening remarks.

F4E and FIIF representatives during the meeting, October 2014

In line with F4E's revamped industrial policy, aiming to promote direct interaction with industry and European fusion laboratories, a communication platform has been established with the Fusion Industry Innovation Forum (FIIF) which represents different commercial and institutional voices from the fusion community. The FIIF was established in 2010 with a clear focus on the fusion roadmap, the various possibilities of technology transfer and the transmission of technical skills to industry in order to give Europe's workforces a competitive edge and help them bring commercial fusion a step closer.

The composition of this body offers F4E a unique opportunity to liaise with a cluster of professionals, which is manageable in number and broad in expertise. Moreover, its mission is congruent with the three areas that F4E is expected to deliver: ITER, the Broader Approach and DEMO. For these reasons, F4E has taken the initiative to host a yearly meeting with FIIF in Barcelona, and offer to all participants comprehensive updates on the state of manufacturing and construction; the tenders in the pipeline and key events.

The F4E Director together with a team of colleagues working in the areas of market and business intelligence, stakeholder relations, contracts and procurement, welcomed the FIIF members and restated their intention to maintain a frank and constructive dialogue. Mr Alain Henri Bernard Chevalier, Chair of FIIF belonging to AMEC UK, confirmed the value of this annual meeting and thanked F4E for this initiative. A series of topics were tackled ranging from F4E's progress report, its industrial policy and future industry incentives.

05

Events

Spreading the word on Europe's contribution to ITER

F4E contributed to several events in order to promote different aspects of its work to diverse target groups such as companies, technology communities, scientists, policy-makers and younger audiences.
In this section we look back at some of the key events that marked the year.

Left to right: Professor O. Motojima, ITER IO Director General, J.M Durão Barroso, President of the European Commission, G. Fioraso, French Secretary of State for Higher Education and Research.© LESENECHAL/PPV-AIX.COM

The European Commission President visited the ITER site

Before the European Commission's mandate came to end, the President of the EU's executive body had on his wish list a visit to ITER. President José Manuel Durão Barroso has led the College of Commissioners for ten years and has been one of the staunch supporters of the project in front and behind the scenes.

He worked directly with Jacques Chirac, French President at the time, in order to secure ITER's seat in Europe and offered guidance to three Commissioners from the areas of research, innovation and energy while in office.

The EU's determination to cut down greenhouse emissions and decrease the energy dependency syndrome from third countries, has branded ITER as an opportunity entirely in line with the political priorities. The prospect of innovation and its direct impact on Europe's competitiveness were additional reasons that "made the European Commission believe in this project" as he explained. Geneviève Fioraso, French Secretary of State for Higher Education and Research, accompanied the European Commission President to the ITER construction site and highlighted the fact that "thanks to ITER, Europe is a young and ambitious continent".

President Barroso met with the F4E members of staff based in Cadarache and the European colleagues working for ITER International Organization. Laurent Schmieder, F4E's Head of Construction and Power Supplies, explained to the policy-makers the European contribution in the field of construction, and outlined the main companies and consortia involved in this domain.

Europe presented its achievements to international media

More than 50 journalists from all over the world have crossed the gates of the ITER headquarters to witness the progress of the biggest international collaboration in the field of energy.

The ITER media trip has become the meeting point for those who are eager to learn more about fusion energy, discover its merits and challenges, understand the complexity of the ITER components and their manufacturing.

Several high-level speakers have been invited to explain key ITER technologies and elaborate on cost and schedule. The presentations covered a broad range of topics such as the overall management of the project, the different interfaces of the ITER assembly, the compliance with the nuclear safety standards. Between sessions, a guided tour on the impressive construction site was planned, with Laurent Schmieder, F4E's Head of site, Buildings and Power Supplies, offering a warm welcome to all participants and explaining how the site has changed over the years. With Europe being responsible for nearly half of ITER's cost, a special media briefing was planned to explain the involvement of F4E to the project and the tangible benefits for Europe's industry and SMEs. Professor Henrik Bindslev, F4E's Director, opened the briefing with a report on what has been achieved so far in terms of construction, manufacturing and the list of incentives given to companies. He highlighted the role played by industry in delivering the ITER components and paving the way towards a fusion energy market.

Companies from different sectors were also invited to elaborate on their contribution and why it mattered to them to be part of ITER. Ferrovial was represented by Oriol Ribas Escola, who outlined the construction process of different ITER buildings and the rigorous specifications that have to be met down to the level of the concrete mix. On behalf of Atkins, Simon Layzell, explained the titanic tasks stemming from the Architect Engineer contract and the compliance with strict nuclear safety standards. Greg Willetts, illustrated the role of AMEC in the field of in-vessel technologies and spoke of ITER as a new knowledge platform for sustainable energy. For Stefano Pittaluga the work undertaken by ASG Superconductors for the Toroidal Field coils, served as an opportunity to retrain staff with new skills and explore the potential of superconductors in the energy market. Finally, Mathias Zorn from the M+W Group, explained the engineering challenges of equipping the most emblematic building of ITER- the Tokamak complex.

The companies conveyed a message of commitment and pride to be associated with the project. Some spoke of ITER as a reference boosting their position in the market and the capacity to recruit talented people. Others highlighted the wealth of skills that they have acquired and their application in other domains. Irrespectively of their visions, they all coincided in one observation: the lessons we draw today from ITER will determine to a great extent tomorrow's energy choices.

Group of journalists visiting CNIM in order to witness the manufacturing of radial plates

F4E informed the fusion community about the latest progress on industrial and business opportunites

The Symposium on Fusion Technology (SOFT) has become one of the most anticipated rendezvous of the fusion community. Every two years the most prominent fusion experts from around the globe meet for five days to discuss the progress of their work, present new breakthroughs, debate the future of their field and network.

The 28th edition of SOFT was celebrated in San Sebastián under the auspices of Spain's Research Centre for Energy, Environment and Technology (CIEMAT) bringing together more than 1,100 participants.

Plenary and thematic sessions grouped high profile speakers to address a vast range of topics such as ITER, DEMO, JET, K-STAR, Weldenstein 7-X, ASDEX and JT-60SA. Round table discussions served as platforms for dialogue about technology transfer and upcoming business opportunities. F4E was present in all activities through a delegation that counted 40 members of staff ready to take questions on the progress of ITER, communicate the latest calls for tender and give an overview of the Broader Approach activities.

The presence of numerous European Fusion Laboratories (EFLs) and Industry Liaison Officers (ILOs) inspired Ana Belén Del Cerro, Spain's ILO, to organise an Info Day gathering more than 180 representatives from companies and laboratories interested to hear more about upcoming calls and potential possibilities of collaboration between the two fusion camps.

More than 180 participants attended the ITER Industrial Info Day

F4E presented ITER business opportunities to Danish industry

All European SMEs must take advantage of the valuable business opportunities that the ITER project offers. Professor Henrik Bindslev, F4E Director, encouraged Danish companies to get involved during a meeting held at the Big Science Secretariat Network meeting in Copenhagen.

F4E and ITER IO representatives were present to provide an overview of ITER technical tasks and future Calls for tender.

Danish Research and Higher Education Minister Sofie Carsten Nielsen also attended the event and spoke strongly in support of fusion energy to the audience of 90 participants who were mainly from the Danish business and research community. Representatives from ITER International Organization together with a delegation made up of technical and business experts from F4E were on hand to provide an overview of ITER business opportunities whilst also explaining the procurement and quality assurance procedures. The presentations highlighted a number of upcoming F4E contracts to be placed in the areas of instrumentation, electronics, machinery, and several research and development activities which require agile and flexible companies. Individual business-to-business meetings were held for especially interested companies in order to discuss specific topics with F4E experts and in the days directly after the Big Science Secretariat Network meeting, F4E experts made a number of on-site visits to relevant companies within the Copenhagen area in order to better understand the technical expertise available within Danish industry.

Italian EU Presidency highlighted the potential of ITER

The Presidency of the European Council of the EU is held every six months by a different member state. Italy found itself in the driving seat of EU integration for the twelfth time in order to set the political agenda.

One of the three priorities, set by one of the EU's founding members, has been economic growth and employment. Europe should kick start its economy, become more competitive, unleash its potential and find inspiration. Science and innovation tick all of the previous boxes because they are vital in Europe's search of an industrial renaissance. Big science projects like ITER enhance this possibility and drive our ambition to think and act big!

Keynote speakers during the opening session of the seminar

This line of thinking led la Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo ecnomico sostenible (ENEA), Italy's National Agency for New Technologies, Energy and Sustainable Economic Development, and Confidustria Lombardia, the confederation of Lombardy's industry, to organise during the Italian Presidency a seminar on "ITER- the way to global competitiveness through European fusion" on 24 November 2014 in Milan.

The seminar brought together 80 participants and a distinguished set of speakers from politics, research, industry and enterprise. ENEA reminded the participants of Italy's proven track record in the field of fusion research. The know-how and the commitment to support R&D in this scientific domain seem to have paid off. The statement was confirmed by F4E's statistics indicating that Italy has secured the second position from all member states, receiving for the period 2008-2014 an amount close to 800 million EUR for its involvement to ITER.
The strategy of investing in big science projects and in fusion energy was also discussed. Policy-makers were of the opinion that not placing all eggs in one basket is the sensible way to go about rethinking Europe's energy policy and stimulating industrial expertise. The unique selling points of big science projects are the de-facto international collaboration with different entities, the critical mass of skills, and the expectation of continuity through a follow up project.

These points were highlighted by F4E contractors present at the meeting, who shared with the rest of the audience the tangible benefits of their involvement. In order to maintain the industrial momentum and keep skills alive there has to be continuity in big projects as such. Unlocking the potential of SMEs and encouraging them through different measures to participate, were also highlighted because of their remarkable flexibility to acquire specialised skills and cope with the evolving demands of the market of innovation.

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