F4E NEWS

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Inside Europe's facility where ten of the ITER Toroidal Filed coils are being manufactured - La Spezia, Italy

Europe celebrates its leadership in magnets technology!

The world's most sophisticated high-tech superconducting magnet is made in Europe. It is 14 m high, 9 m wide and weighs 110 T—as much as a Boeing 747! This is the first of the 18 Toroidal Field (TF) coils that will operate in ITER, the biggest fusion machine that will demonstrate the potential of this energy source.

The most high-tech magnet in history manufactured with the contribution of F4E and its industrial partners - ASG Facility, La Spezia, Italy

The coils will create a powerful magnetic cage that will entrap the fusion fuel which is expected to reach 150 million ° C. When powered with 68 000 A, the ITER TF coils will generate a magnetic field that will reach 11.8 Tesla—about 1 million times stronger than the magnetic field of the Earth! Europe will manufacture nine of them, plus one spare. The other nine will be fabricated in Japan.

To celebrate this landmark achievement, F4E together with ASG Superconductors, Iberdrola Ingeniería y Construcción, Elytt Energy, CNIM, SIMIC and the ICAS consortium, participated in a small ceremony which brought together 80 representatives from industry, stakeholders and the media. At least 600 people from 26 companies have been involved in Europe's share of TF coils. ITER has given European industrial partners a one-of-a kind opportunity to extend their know-how, employ and train workforces, and identify potential markets in the field of superconductivity.

Davide Malacalza, Managing Director of Hofima SpA and Chairman of ASG Superconductors, opened the event giving a warm welcome to all guests by offering an overview of the group's activities. ASG counts a collaboration of more than 50 years with EU research centres. The company has become a pioneer in magnets technology and has managed to retrain its staff by being involved in scientific and medical projects. Massimo Federici, the mayor of La Spezia, congratulated the people involved in this milestone and stressed the economic effects stemming from the industrial facility for the city and the region. The transformation of this facility has also been addressed by Edoardo Rixi, regional councilor of Liguria for industry, who explained that equipping people with new skills helps us to unleash their potential and that of the region.

Bernard Bigot, Director-General of ITER Organization, praised the collaboration of all companies and described ITER as a project full of opportunities for big and smaller economic operators. The need to generate a sustainable energy source and the challenges posed by climate change require a global alliance in line with what ITER proposes. Johannes Schwemmer, Director of F4E, presented the merits of fusion energy, elaborated on Europe's contribution to ITER and focused on Italy's record in the production of ITER components commenting on the strong involvement of its industry.

Davide Malacalza, Managing Director of Hofima SpA and Chairman of ASG Superconductors presenting the work of ASG

Edoardo Rixi, Regional Councilor of Liguria for Industry

Johannes Schwemmer, Director of Fusion for Energy, explaining Europe's contribution to ITER

Bernard Bigot, ITER Director-General of ITER Organization, congratulating Europe for this achievement

Representatives of F4E and ITER Organization together with Europe's industrial partners (ASG Superconductors, CNIM, Elytt, Iberdrola Ingenieria y Construcción, ICAS, SIMIC) at the facility where ten of the ITER Toroidal Filed coils are being manufactured - La Spezia, Italy

Representatives of the F4E and ASG workforces at Europe's ITER Toroidal Field coils facility, La Spezia, Italy

Through their interventions, the representatives of the different companies helped the audience to comprehend the different phases of manufacturing and the challenges they faced along the way. This impressive achievement results from various contracts starting with the production of a 20 km conductor for the TF coils, involving ICAS, the Italian Consortium for Applied Superconductivity consisting of ENEA, Criotec Impianti Srl and TRATOS Cavi SpA. Antonio della Corte, President of the ICAS consortium and Head of ENEA Superconducting Laboratory, explained that "our contribution to the superconducting conductor for the ITER magnets allowed us to develop new ideas which improved our production technologies and use them in different applications."

ASG, Iberdrola Ingeniería y Construcción and Elytt, have used parts of this conductor to manufacture Europe's first TF coil magnet. A vast new facility, which used to be the site of a washing machines factory, has been constructed and has become a hub of expertise by retraining its original workforce and installing state of the art equipment. Stefano Pittaluga, ASG Superconductors, stated that "thanks to ITER, and our company's leadership in fusion magnets technology, we now see new possibilities of growth in the energy sector. We are ready to use this knowledge in new industrial applications." And in fact ASG has contributed to some of the most advanced magnetic resonance imaging (MRI) equipment used in healthcare to study the human brain.

Andrés Felipe, Project Manager of Iberdrola Ingeniería y Construcción, explained that "by being part of ITER, a project which will test the energy of the future, we have been given the opportunity to demonstrate our know-how and in return acquire further expertise in engineering." For Aitor Echeandia, CEO of Elytt, the commercial benefits have been concrete. "Because of our involvement in the manufacturing of ITER magnets, our SME has acquired further competences in superconducting technologies for fusion and particle accelerators."

SIMIC and CNIM have been involved in the production of the 70 radial plates of the magnet, the metallic structures that support the insulated conductor in their grooves before the structures are laser welded, wrapped with insulating material, and impregnated. Both companies have upgraded their facilities, employed people and trained them to deliver their share of components respecting a tight schedule. Marianna Ginola, SIMIC Commercial Manager, explained that "we have managed to grow as a company and improve both in terms of project management and in technical aspects." According to Philippe Lazare, CEO of CNIM Industrial Systems Division, "in order to manufacture our share of ITER components we had to upgrade our industrial facilities, establish new working methods and train new talent. In return, we have become a French reference in high-precision manufacturing for large components."

The first magnet will be transferred to SIMIC to perform a series of tests. Then, it will be inserted into a massive case, welded, impregnated by resin and machined using the most advanced technologies, special tooling and one of the largest machines in Europe. Each TF coil will weigh over 300 T and will be transported via sea from SIMIC to the site of the ITER project.

During the event, a guided tour in ASG was organised offering all guests the possibility to view the different tooling stations and magnets in progress. For Alessandro Bonito-Oliva, F4E Manager of Magnets, and his team, this has been an accomplishment of significant importance. "Thanks to our determination and the excellent collaboration between F4E and its partners we have completed the core of Europe's first TF coil. This is the result of the good cooperation between the different parties of this one-of-a kind project. A clear proof that when Europe wants to be a pioneer-Europe can!" he stated.

If you would like to take a virtual tour in the facility visit F4E's Facebook page or use the Roundme application.

(L-R) Aris Apollonatos (F4E), Alessandro Bonito-Oliva (F4E), Antonio della Corte (ICAS), Philippe Lazare (CNIM), Stefano Pittaluga (ASG), Paolo Barbero (SIMIC) during the panel discussion.

(L-R) Stefano Pittaluga (ASG), Neil Mitchell (ITER Organization), Bernard Bigot (ITER Organization), Alessandro Bonito-Oliva (F4E), Johannes Schwemmer (F4E) during the guided tour in the facility commenting on the terminations of the winding pack.

Army of cryogenic tanks invades the ITER site

More tanks of the ITER Cryoplant departed from Fos-Sur-Mer, the industrial port of Marseille, and have been delivered to the construction site. The large pieces of equipment, measuring approximately 25 m, were stored in the facilities of the port until it was time to transport them to Cadarache.

Two of the six gaseous helium (GHe) tanks arriving at the industrial port of Marseille, May 2017 © DAHER

The countdown for the complex logistics operation, performed by DAHER, started a few weeks ago signaling the end of their long journey. Six of the tanks had crossed the sea all the way from China and one had come from Turkey. All components have been manufactured by Air Liquide, and their suppliers, as part of Europe's contribution to ITER managed by F4E.

As various convoys of the voluminous equipment were crossing the streets and highway of Provence, many people stopped and stared. It was like watching a parade in slow motion where an army of white/beige containers was marching gracefully determined to conquer the site. As part of ITER's cryogenic system they would play an important part in the operations required to cool down the machine to -269 ℃ and store the gases. Basically, they would come to play after ITER's heating systems raise the temperature of the fusion fuel to 150 million °C. An army of components designed to deliver cold power was getting ready to wage war against those that would produce fire.

Six gaseous helium (GHe) tanks have been manufactured to recover the gas from the machine and provide a buffer during operation. Each of them, measuring 25 m, will store roughly 800 kg of helium.One liquid nitrogen (LN2) tank has also been delivered, whose main task will be to work as a back-up in case there is a failure in the LN2 plant. The tank weighs 115 T and when it stores the gas it will be able to sustain a load of 340 T. The seven tanks have joined the two quench tanks, already delivered last year, raising the total of Europe's cryogenic components on-site to nine. And in the next few weeks, the liquid helium (LHe) tank manufactured in Sweden, is also expected to reach the construction site.

Unloading the liquid nitrogen tank (LN2) at the industrial port of Marseille, May 2017 ©DAHER

An army of gaseous helium (GHe) tanks heading towards the ITER construction site, June 2017 ©ITER IO

One of the six gaseous helium (GHe) tanks delivered to the ITER construction site, Cadarache, June 2017

(L-R) Helium Plant Cold box stationed next to the gaseous helium (GHe) tanks and the liquid nitrogen (LN2) tank on-site, Cadarache, June 2017 ©ITER IO

The Cryoplant facility under construction, ITER construction site, Cadarache, June 2017 ©Engage

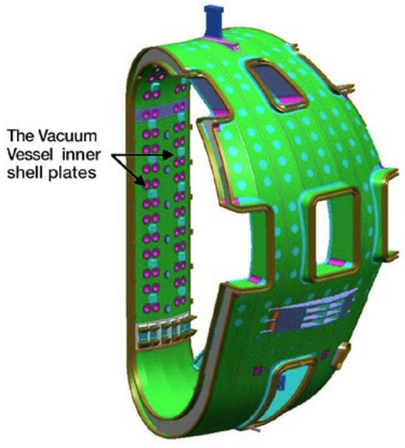
The embedded anchors indicate the exact positions where the tanks need to be installed on-site, Cadarache, June 2017 © Engage

Meanwhile, the civil engineering works of the Cryoplant facility are being completed. The teams have concluded the works on the roof and are now focusing on the second layer of cladding. The helium plant Cold boxes are being installed, paving the way for the rest of the components to follow early next year. On-site, in the area where the massive tanks will be installed, the first layer of concrete has been poured and the embedded anchors, which indicate their exact positions, have been put in place.

Vacuum Vessel: first parts manufactured by ENSA completed

ENSA (Equipos Nucleares S.A), as part of the AMW consortium, has achieved a key F4E milestone: the machining of two inner shell plates – the first pieces to be manufactured at ENSA – has been completed. These plates will make up the longest of the segments of the ITER Vacuum Vessel's sector 3, and measure each 6 m long, 1.5 m wide, and has a thickness of 60 mm.

One of the two inner shell plates – the first pieces to be manufactured at ENSA.



The inner shell plates make up the long part of the Vacuum Vessel sector.

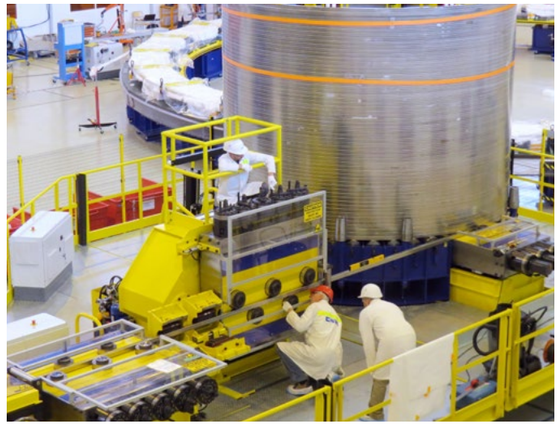
The plates are made up of the special ITER grade stainless steel. The long length of each plate has entailed a number of challenging steps involving cleaning; cutting and machining of holes which will house the so-called flexible housings (large cylindrical parts which act as bolts); as well as carrying out a wide variety of inspection techniques in order to detect the presence of defects, characterise findings, and measure without causing any damage to the plates themselves (known as Non-destructive Examination – NDE). What makes this work additionally challenging is the fact that the flatness tolerance (the permissible limit or limits of variation in the overall flatness of each plate) is very tight – only a 0.4 mm variation in 6 m is permitted. With the right techniques, the necessary flatness tolerance for the plates has been achieved, even despite that the longer the length of the piece, the more difficult it is to attain the same overall flatness.

"This milestone achievement shows the commitment of ENSA as part of the AMW consortium to delivering Europe's Vacuum Vessel contribution and its key role in the success of the Vacuum Vessel manufacturing", says Rafael Treviño, Director General of ENSA.

"F4E is pleased with ENSA's performance: they keep their commitment whilst anticipating and mitigating issues. ENSA has lived up to its reputation of being one of the best European companies in the nuclear field", says Francesco Zacchia, Project Manager for F4E's Vacuum Vessel Team.

The manufacturing of the ITER Poloidal Field coils has started

The team of engineers from F4E, ASG and CNIM, working in Europe's industrial facility on the ITER site, and their colleagues in ASIPP, the Institute of Plasma Physics of China's Academy of Sciences, have officially started manufacturing the Poloidal Field (PF) coils assigned to Europe for the biggest fusion device –ITER.



CNIM technicians supervising the manufacturing of the European Poloidal Field coils in F4E's Facility, Cadarache

The Winding of the first Double Pancake of Poloidal Field coil 6 has been completed, ASIPP, China

ITER will operate with six PF coils. Europe is responsible for five of them and through a collaboration agreement with China one will be fabricated in ASIIP. The remaining coil will be delivered by Russia.

After having successfully completed the winding tests using lengths of dummy conductor, the technicians have started unspooling the "real" conductor and inserted it in the machines to produce the impressive magnetic rings that will control the shape and stability of the super-hot plasma.

In ASIPP, the winding of the first Double Pancake (DP), which consists of two layers of conductors wound in the shape of massive pancakes, started in mid-March and has been completed. Works on the two Helium inlets at the inner joggles, from where Helium will circulate in the conductor to lower its temperature to freezing levels so as to make the coil superconductive, have been concluded. Carefully milling a hole in the jacket, without damaging the superconducting strand underneath, and welding a pipe to feed the helium into the conductor, have been some of the additional delicate works that needed to be performed. This weld has then been X-Rayed and leak tested to ensure that no Helium can escape through the weld. Subsequently, the Helium inlet insulation has then been wrapped around the inlet. On average, the winding of a DP is expected to take 4-5 weeks each.

After a series of rigorous dimensional checks, in order to check whether the shape and dimensions of the component are in compliance, the component will be transferred to the terminal assembly area. The DP will enter its final stage of fabrication by going through Vacuum Pressure Impregnation, where the necessary vacuum will be created to inject the epoxy resin and cure the insulation.

Meanwhile, a few months ago in F4E's PF coils facility, CNIM has already started winding the conductor of the fifth PF coil and the first DP is expected to be completed by the end of May. When the first layers will be completed, the team of technicians will proceed with the installation of the Helium inlets and perform the same steps as in ASIPP.

The good collaboration between F4E, ASIPP and their industrial partners, has been fundamentally important in making good progress in a co-ordinated way. The engineers and technicians supervising the works are witnessing the moment they have all been waiting for: the winding tests are over and the coils are being manufactured for real!

CNIM delivers the final radial plate for Europe's Toroidal Field coils

Europe's final radial plate, which will house in its finely machined grooves the superconducting conductor of the ITER Toroidal Field coils (TF), has been manufactured. The contract signed between F4E and the consortium of SIMIC and CNIM for a value of 150 million EUR, has been successfully concluded.

Loading Europe's last radial plate manufactured by CNIMTED on behalf of F4E

On Tuesday 23 May, the impressive D-shape component measuring 13 x 9 m and weighing roughly 10 T, sailed from the port of La Seyne-Sur-Mer (France) to La Spezia (Italy) to join the production line of Europe's TF coils unfolding in the facility of ASG Superconductors.

The production of all 70 radial plates has been completed in line with the tight schedule and budget. The collaboration of the two companies, which are different in size and are operating in two different countries, is in itself a European success story. They have shared the workload, their know-how and have worked hand in hand to meet the requirements of this demanding task. This partnership is also congruent with the spirit of international collaboration that the ITER project promotes.

Over the last four and a half years in this facility, which CNIM has upgraded with new tooling and new people, the high-tech machines have been working relentlessly under the supervision of teams rotating three times per day. After having completed the inspection of the last radial plate, the component has been carefully packed, loaded on MV STAPELMOOR, the vessel to deliver it safely to Italy.

The material used, the quality of welding, the scale of the parts, the dimensional tolerances and the pace of manufacturing have made

Representatives of CNIM and SIMIC. The two companies were responsible for the fabrication of Europe's 70 radial plates.

Philippe Lazare, CEO of CNIM's Industrial Systems Division and Managing Director of the Facility at La Seyne-Sur-Mer

Jean-Claude Cercassi, CNIM's Development Director for the ITER Programme

Eva Boter, F4E's Technical Officer responsible for the Radial Plates contract and Alessandro Bonito-Oliva, F4E's Project Manager of Magnets

this a very complex project, both in terms of technology and project management. CNIM has met these challenges by adapting its range of industrial tooling. "Programmes like ITER are great accelerators of innovation", explains Philippe Lazare, CEO of the Industrial Systems Division. "CNIM's ability to be reactive and mobilise its resources is a real asset." The company has therefore acquired two 15 x 10 m portal machines for the fabrication of large parts, housed in a bespoke air-conditioned 3 000 m² facility with direct access to the sea, which is vital for the transportation of the radial plates to Italy.

The processes implemented for the production of the radial plates – electron beam welding in local vacuum and final machining – were developed as part of an internal R&D programme, and then under a contract with F4E between 2009 and September 2012. This made it possible to achieve exceptional levels of performance in terms of tolerances and welding quality. "We have successfully overseen the forging of stainless steel blanks of very large dimensions, constantly pushing the boundaries of technology", says Jean-Claude Cercassi, CNIM's Development Director for the ITER Programme.

The fabrication of the radial plates has been counting more than 300 000 hours of work for CNIM, which has been carried out by at least sixty employees. "Thanks to the commitment and mobilisation of the teams, CNIM has managed to deliver a product of high quality while respecting the delivery schedule of one radial plate every three and a half weeks", explains Jacques Silva Ribeiro, CNIM's Manufacturing Methods Manager. "We have made considerable improvements in our project management methods particularly by involving our partners more and through the systematic implementation of back-up plans."

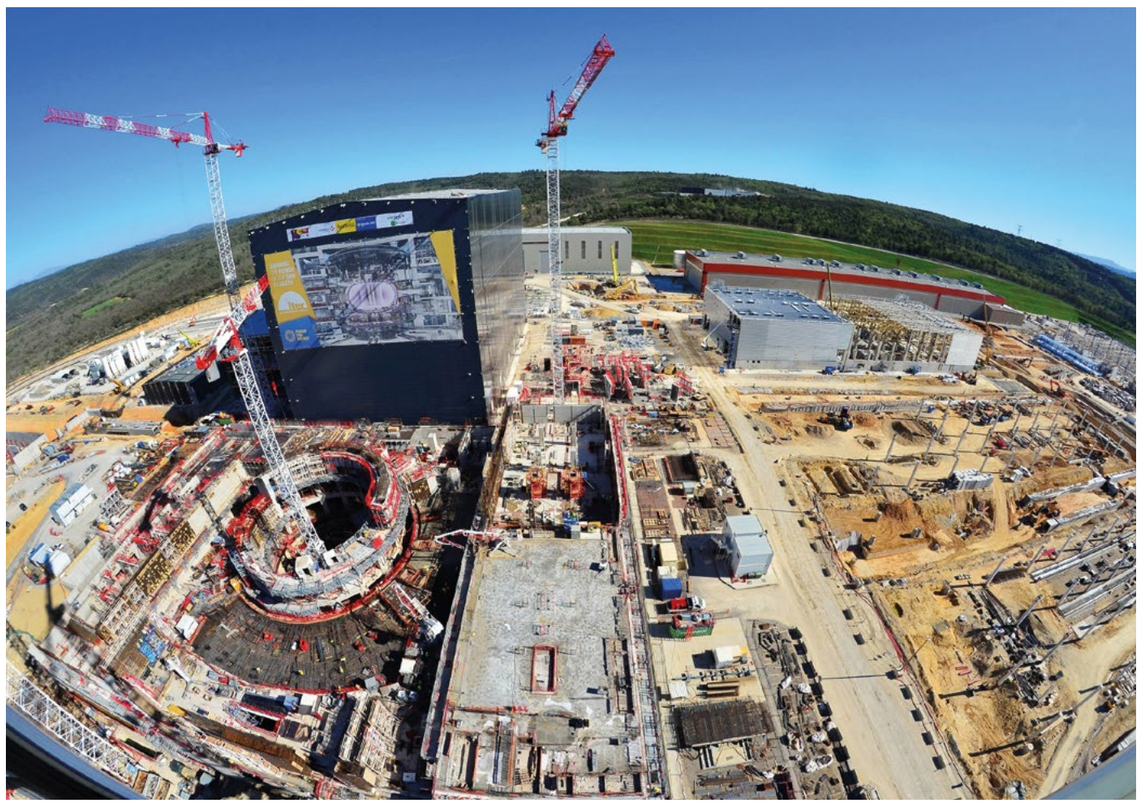
Eva Boter, F4E's Technical Officer managing this contract, recalls how it all started: "We needed to develop a series of smaller prototypes in order to reach the full scale components. It was an exercise in many stages. With every step we made we gained confidence. I remember when we presented at MT-22, the Magnets Technology conference, parts of the real size mock-ups of the radial plates, and people were gathering to view them. They were fascinated by the machining and precision that underpin this equipment."

Alessandro Bonito-Oliva, F4E's Project Manager of Magnets, remembers the first information meeting that took place almost eight years ago where companies expressing interest in the fabrication of the radial plates were invited to F4E. "We have come a long way since that meeting where we needed to figure out who was interested in their production, understand if they had the know-how and whether they would they be inclined to compete. Today, we stand in front of the final radial plate ready to find its way to ITER. I would like to congratulate our industrial partners for this achievement and the members of the team. Europe has proudly concluded one of its main contracts in the area of magnets."

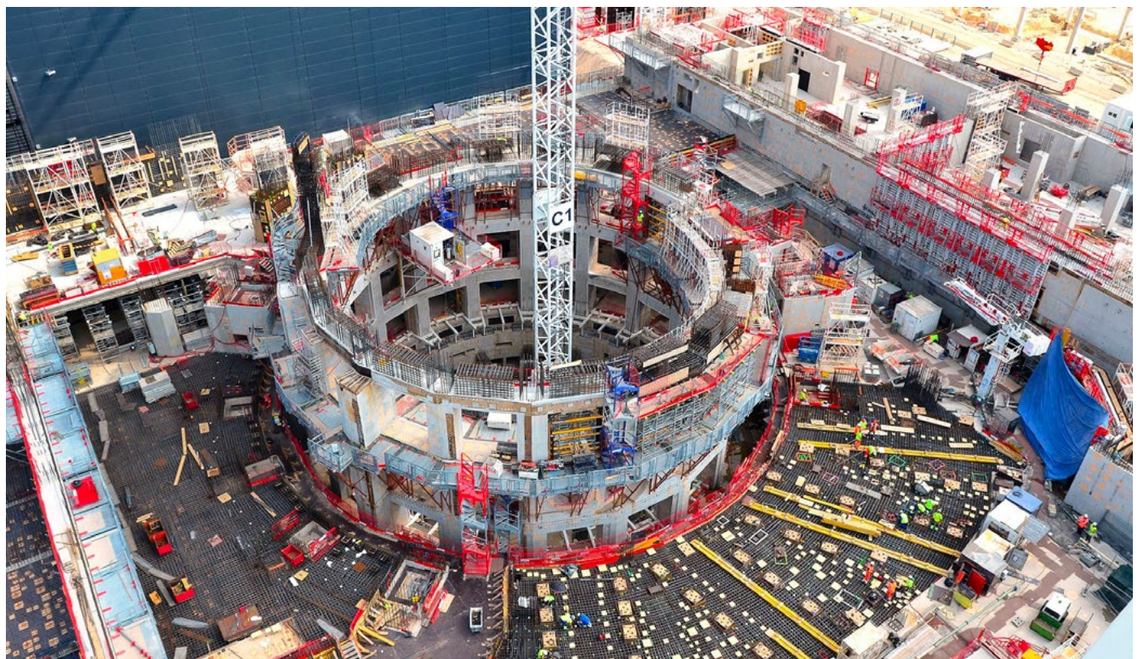
Representatives of F4E, CMIN and SIMIC standing inside the final radial plate which will be used in the manufacturing of the 10 ITER Toroidal Field coils procured by Europe.

ITER Wonderland

It has been seven years since F4E signed its first major contract in the field of construction with the Engage consortium for the works to be carried out by the Architect Engineer. The teams of Atkins, Assystem, Egis and Empresarios Agrupados have been entrusted with the development of the designs of the ITER buildings and infrastructure. Together with F4E and ITER Organization they have undertaken the responsibility to support the engineers to design and build the 39 facilities. In addition, they have co-ordinated the works that will unfold in parallel. It was hard to imagine the volume of the works without any infrastructure on the 42 hectares of the ITER platform.



ITER construction site, April 2017, © ITER IO



Civil engineering works progressing at the bioshield, ITER site, June 2017 © ITER IO

The embedded plates can be viewed on the level above © ITER IO

The progress of the slab and walls of the ITER Tritium building, April 2017 ©LNM

Today, however, there are 1700 people working on the ground and the ITER site has changed. It resembles to a new land which is getting ready to host one of the biggest experiments of our times. Those visiting the site acknowledge that the progress has been noticeable in most areas. F4E has signed 70% of the contracts for buildings and around 40% of the works have been completed.

The civil engineering works of the bioshield, a cylinder made of concrete which will be 30 m high, have progressed rapidly. Up to 90 people have been working on two shifts to meet the tight deadlines. Its fourth floor (level 3) is under construction and its third floor (level 2) is 60% completed. Towards the end of July, a temporary lid will be placed on its top level and works will continue to be performed inside with the help of mobile cranes. The Vinci Ferrovial Razel (VFR) consortium is advancing with the construction of the slab of the second floor (level 1) of the Tokamak and Tritium buildings as well as their walls. The progress of the works on the slabs and walls of the Diagnostics building has already reached the third floor (level 2) giving an impression of how big the central facility of the ITER machine will be.

The mesh of rebars, concrete and reinforced steel which lie beneath this massive facility will also integrate 115 000 embedded plates, thick steel plates which will be anchored deep into the concrete and positioned with accuracy to match the location of the ITER equipment that will be finally installed. Today, according to our measurements, more than 40 000 of them have been installed with an accuracy of 98%! The level of precision is remarkable.

Painting and cleaning activities are in progress in the Cleaning Facility and will soon start in the Assembly Hall which is

The impressive ITER Assembly Hall (dark metallic structure) and Site Services buildings (adjacent to the right), April 2017 © Engage

getting ready to welcome the first piece of equipment coming from Korea's ITER Domestic Agency in June. Cabling and the installation of HVAC (Heating Ventilation and Air Conditioning) are also advancing. After summer, this facility will be handed over to ITER Organization so that tooling for the assembly of the first sector of the ITER Vacuum Vessel is stored. The leaves of the big sliding doors, from where the components will be delivered, are being installed and the cranes are being tested and commissioned.

A few metres next to where the heavy ITER components will be assembled is the Site Services building. The 80 metre-long edifice will provide other facilities with chilled water, and amongst other utilities, it will host a demineralised water plant and air compressors. The civil works are almost completed and HVAC and cabling are ongoing. The first equipment is expected to arrive soon and its chiller room is ready to be connected to the piping system.

The civil works of the Cryoplant, the sophisticated "refrigerator" of the ITER device, have been completed. Currently, the teams are performing works on the roof of the building and the cladding is well under way. The Cold boxes, will be the first pieces of equipment to be installed on-site in June.

At the Radio Frequency building works are progressing as planned. The prefabricated beams have been installed, the cladding, roofing and internal works are on-going so that the facility is ready by the end of July. Towards the end of the year, the teams will start installing the first pieces of equipment. Meanwhile, as far as the electricity infrastructure is concerned, which has been entrusted to Ferrovial, the structure of the electrical power distribution building is on-going and is expected to be completed by the end of July in order to host the first equipment in September.

The excavation of the galleries that will connect the various facilities underground is also advancing. The consortium of Spie batignolles, Valerian, Atelier De Fos, in charge of the work, has started digging around the platform. During the next months, the works linked to these deep trenches will accelerate in order to construct a labyrinth of galleries. The works to follow will consist of piping, backfilling and surface works.

Without a doubt, the activity on the ITER site has increased and it is visible in many areas. The workforces have multiplied, more buildings are being constructed and the installation of more equipment will soon open a new chapter. When visitors from different parts of the world receive a guided tour on the ITER platform, they are genuinely impressed not only by its size but mostly by its potential to deliver the energy of the future.

Winding the final conductor for Europe's ITER Toroidal coils

Under the massive cases of the ITER Toroidal Field coils (TF) and the multiple components which have been insulated, wrapped and impregnated to form the magnet, various lengths of superconductive conductor lie beneath. They nestle in the grooves of the finely machined pieces of equipment and when ITER is in operation they will carry current to the core of these massive magnets to generate the magnetic field required to confine the super-hot ITER plasma.

Technician checking the tooling used for the winding of the conductor for the ITER Toroidal Field coils, ASG Superconductors, La Spezia, Italy

Winding the final conductor for Europe's ITER Toroidal coils, ASG Superconductors, La Spezia, Italy

Europe's final conductor has been wound in the ASG Superconductors facility, Italy, where F4E is manufacturing the 10 winding packs—the core of the TF coils. F4E's industrial partners: Luvata, Oxford Instruments Superconducting Technology, Bruker European Advanced Superconductors, ENEA, Tratos Cavi Spa and Criotec Impianti Srl have all contributed to the fabrication of the conductor. China and Russia have also produced conductor lengths which have been used by Europe for its TF coils. After six years of meticulous work, the winding tooling has performed the final bending operation with a millimetric precision of 0.05 mm/m.

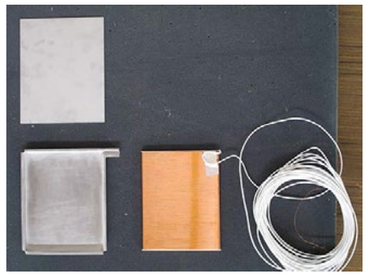
Each conductor is formed by a cable of roughly 1400 Niobium Tin and copper strands fitted inside a stainless steel conduit of about 45 mm diameter. After arrival on-site, it is leak tested, before it is moved to the winding station where it is de-spooled, cleaned and sandblasted and finally, bent into a spiral D-shape trajectory, just like the shape of a TF coil. When two layers of conductor are wound they form a "Double Pancake" (DP). For Europe's TF coils, 70 DPs have been produced in total. Depending on the type of the DP, the conductor length may vary between 760 m for a regular DP or 450 m for a side DP.

Winding takes roughly one week and teams of technicians are constantly overviewing the process. On completion, the remainder of the DP manufacturing process will take approximately eight months. Afterwards, it should be ready to be assembled into the last TF coil winding pack due for delivery in 2019. Robert Harrison, F4E's Technical Officer following the works closely, explains that "the precision achieved has been the most remarkable aspect of this process and bears credit to the staff and engineering involved."

Alessandro Bonito-Oliva, F4E's Project Manager of Magnets, explains that "this is the most critical manufacturing phase. The success of all subsequent manufacturing operations depends on the accuracy of the winding. This is also the first manufacturing step of the winding packs that we will not be repeating. The excellent collaboration between our partners and the good co-ordination of all technical interfaces has brought this operation to a successful conclusion. For Europe's TF coils, the winding of the conductor is over!"

Contract signed for Diagnostic Outer Vessel Coils

F4E has signed a contract worth 2 million EUR with Elytt, a company based Spain, for the manufacturing of more than 400 coils which will be installed on the outer surface of the ITER Vacuum Vessel.



One of the Continuous External Rogowski (CER) coils undergoing acceptance testing earlier this week at the ITER site

These coils will measure the magnetic field strength surrounding the core of the ITER machine, and will thus contribute to determination of key parameters such as the shape and position of the plasma inside, during reactor operations.

"This is a technically challenging task, as these coils must last the entire lifetime of ITER without maintenance, after their installation on the machine", says Glenn Counsel, F4E's Manager of the Diagnostics Team.

The Outer Vessel Coils are part of the ITER magnetics diagnostic. The location of these diagnostics on the exterior, rather than the interior, of the ITER Vacuum Vessel means that measurements are less accurate but advantageously more robust as they are much less exposed to neutrons released during the fusion reactions.

Elytt will be supplying coils in various sizes, with external dimensions in the range of 150 - 300 mm and thickness of 11 mm, to fit in the narrow space between the ITER Vacuum Vessel and its surrounding heat shields.

The initial design concept for these coils was developed by ITER IO. On this basis, a detailed design was developed under an F4E grant led by CEA (France) supported by CRPP (now SPC - Switzerland) and CIEMAT (Spain). Final (manufacturing) specifications, to be used by Elytt, were subsequently developed by ITER IO.

Delivery of these coils to ITER IO for installation on the ITER Vacuum Vessel is foreseen for mid-2018. They will be commissioned, along with the rest of the magnetics diagnostic, once integration of the ITER machine has been completed, for use during first plasma operations.

Spain and Croatia express interest in hosting IFMIF-DONES facility

The DEMO Oriented Neutron Source (DONES) infrastructure will help fusion scientists to test materials in an environment mimicking the conditions of the Demonstration fusion reactor (DEMO), the machine that will come after ITER.

DONES Technical information session, September 2016, Fusion for Energy

Thanks to a series of tests and studies that will be conducted in this facility, we will be increasing our know-how and expertise in fusion energy and get closer to delivering it. At present, through a scientific collaboration between Europe and Japan, known as the Broader Approach Agreement, three scientific projects contribute towards the design of future fusion reactors beyond ITER. The International Fusion Materials Irradiation Facility (IFMIF), in its Engineering Validation and Engineering Design Activities (EVEDA) phase, is one of them. And when it comes to an end, DONES will take over.

Spain and Croatia are the two EU member states that have expressed interest in hosting the prestigious R&D facility. F4E, acting as co-ordinator for the European activities of the Broader Approach, has been the recipient of these two expressions of interest and during a technical meeting, scheduled which took place on 10-11 May, the members of the technical panel evaluating the DONES files agreed on a timeline. Between June and July, the panel is planning to visit the sites aspiring to host the IFMIF-DONES facility and during autumn all information will be reviewed in order to communicate by the end of the year a formal opinion to the Governing Board of F4E, consisting of the member states of Euratom and the European Commission.

ENEA Brasimone successfully concludes corrosion and erosion tests on materials

Fusion energy machines will require materials that can sustain the radiation coming from neutrons without presenting substantial degradation. The International Fusion Materials Irradiation Facility (IFMIF), currently in its Engineering Validation and Engineering Design Activities (EVEDA) phase, is part of the Broader Approach Agreement signed between Europe and Japan. It aims at performing tests and the qualification of materials mimicking the environment of a future fusion power plant. Europe mainly contributes to this project through the IFMIF design, a prototype accelerator, test modules development and Lithium corrosion tests.

IFMIF/EVEDA Project Committee members and representatives from the laboratories contributing to the project met at ENEA Brasimone, Italy.

IFMIF/EVEDA Project Committee members and representatives from the laboratories contributing to the project met at ENEA Brasimone, Italy.

ENEA's LiFus6 facility in Brasimone is a unique test facility, built for the IFMIF/EVEDA project, where erosion and corrosion tests are carried out on Reduced Activation Ferritic Martensitic (RAFM) steels by exposing them to Lithium flowing in line with IFMIF conditions. The task is challenging and its results are vital for the future of the fusion community. Earlier in the year, several scientists met to review the results of the tests after having exposed to liquid Lithium samples of EUROFER97 and F82H, which are types of RAFM respectively developed in Europe and Japan, for approximately 4000 hours. The successful completion of this task and the good results called for a ceremony bringing together the IFMIF/EVEDA Project Committee members; representatives from QST and MEXT (Japan); delegates from the European Commission, ENEA, F4E, EUROfusion, KIT and the University of Florence (Europe).

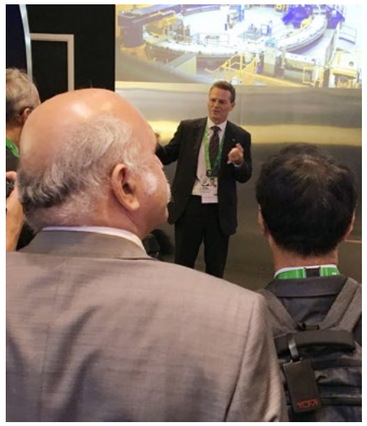
The tests have been extremely useful for two main reasons: first, they have demonstrated that scientists can safely operate IFMIF without any major concerns regarding the corrosion/erosion of the steel materials tested and second, on the basis of the results obtained, we have acquired a better understanding of the factors leading to steel degradation and of the ways to improve the design and development of key components, such as the ITER breeding blankets, where the fuel of future fusion reactors will be produced.

The doors of the LiFus6 facility are open to other projects testing stainless steel materials such as a project conducted by EUROfusion for the engineering design activities of the IFMIF-DONES design.

ITER shines bright as a future energy at the World EXPO 2017

The 2017 world EXPO theme of "Future Energy", EU Vice-President Šefčovič's and Russia's comments, about fusion as the carbon-free long-term option to fill the baseload energy gap, resonate directly with the ITER project and the work of F4E.

The F4E Director, the ITER Director-General and the Heads of the ITER Domestic Agencies in China, Korea and Russia at the fusion exhibition at the 2017 World EXPO.



F4E Director J. Schwemmer highlighted the fruitful collaboration between F4E & QST

This year's World Expo hosted in Astana, Kazakhstan, kicked off on 10th June and featured a futuristic glass-walled 80-metre-in-diameter central sphere surrounded by the nationally-themed pavilions of a 100 countries, the exhibits of ten international organizations, and grounds designed to host over two million people during the coming three months. The theme of this year's event is "Future Energy" – a topic which clearly resonates with the ITER project and the work of F4E.

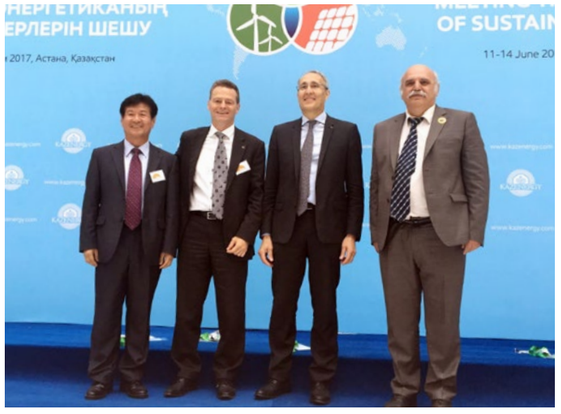
In keeping with France's role as Host to the ITER project, the ITER Organization was invited to participate as an international presence within the French Pavilion. Multimedia tools, models, displays and virtual reality showcased the benefits of fusion as a potential source of safe, clean and virtually unlimited energy, the international collaboration behind the ITER project, and the construction status of this the world's largest and most complex undertaking in the history of science.

F4E Director, Johannes Schwemmer, attended the inauguration of this ITER exhibition together with ITER Director-General Bernard Bigot, the Heads of the ITER Domestic Agencies in China, Korea and Russia, and member of the French Commission of Energy Regulation, Pascal Lorot. "Fusion is what powers the sun and the stars, and 'solar fusion' as I like to call it, has the potential to provide sustainable, clean baseload electricity for future generations", said the F4E Director.

"I am proud that F4E is providing the EU contribution to the ITER experiment – about half of the entire project – and that our work brings together companies and research organisations from all over Europe", he added. "The future of fusion – like the future of science – is partnership", said the ITER Director-General during the inauguration.

Fusion energy was also showcased in the World EXPO's Chinese Pavilion where an impressive 4D cinema show which underlined humankind's need for fusion energy and an innovative model of the ITER machine that used holographic animation featured. In the central EXPO sphere, visitors could climb into a model of the KTM

The European Commission Vice-President for Energy Union, Maroš Šefcovic, highlighted the importance of fusion during his keynote speech.



From left to right: Head of the ITER Domestic Agency in Korea K. Jung, the F4E Director J. Schwemmer, the ITER Director-General B. Bigot, and the Head of the ITER Domestic Agency in Russia A. Krasilnikov at the Ministerial meeting.

The ITER project was showcased at the World EXPO event through multimedia tools, models, displays and virtual reality.

The signing of the cooperation agreement between the ITER Organization and the Republic of Kazakhstan.

(Kazakhstan Tokamak for Materials studies) tokamak.

Attended by ministers of energy, leading world experts and heads of the most authoritative international energy organizations, a ministerial conference entitled "Meeting the Challenge of Sustainable Energy" took place on 11th June in Astana. The conference's key objective was to seek answers to clean energy challenges, develop solutions for the sustainable use of natural energy resources, and establish partnerships in energy efficiency and transfer of green technologies. The agreements reached by the ministers in Astana will be reflected in subsequent work on fulfilling collective arrangements in the framework of the United Nations. The European Commission Vice-President for Energy Union, Maroš Šefčovič, and Alexander Novak, the Minister of Energy of the Russian Federation, both spoke of the importance of fusion in their keynote speeches during the plenary ministerial dialogue, stressing how important fusion is in the energy mix and how it can contribute to reducing global greenhouse gas emissions. United Nations representatives clearly stated that, even if the US would continue to work towards them in a committed manner, it is very unlikely that the established Paris Agreement goals will be met, and therefore new technologies are needed. "These comments demonstrate the significance of the ITER project and the work of F4E", acknowledged F4E Director, Johannes Schwemmer.

In the margins of the ministerial conference, a cooperation agreement was signed between the ITER Organization and the Republic of Kazakhstan, with the ITER Organization officially welcoming the National Nuclear Center of the Republic of Kazakhstan (NNC-RK) as a new technical collaborator. The cooperation agreement encompasses scientific and engineering cooperation between the two institutions, including the technical exchange of experts, access to Kazakhstan's KTM tokamak for materials testing, and the development of diagnostics for ITER.

European Commission presents a communication on the ITER project

On 14 June 2017, the European Commission adopted a communication presenting the revised schedule and budget estimates for the European participation in the ITER project.

A new baseline for the project plans the first experiments for 2025 and full power operation by 2035. Europe has played from the start a leading role in the project, in close collaboration with the countries contributing to ITER – the US, Russia, China, India, Japan, and Korea. The European contribution, channelled through Fusion for Energy, represents 45% of the construction costs of the project (the share will be less once it is in operation).

Since the turnaround of the project 2015-2016, milestones have been set by the ITER Council to allow close monitoring of the project's progress. To date, all the project milestones due have been completed, and the pace of construction is steadily increasing both on-site (primarily construction of the buildings), and off-site: industry in Europe and worldwide is in full production and the first big components are due to be delivered by the end of this year.

The new schedule and its associated costs, together with the substantial improvement in the management of the project in the last two years, provide the necessary ground for the Commission to request the support of the European Parliament and a mandate from the Council of the EU to approve the new baseline of the project on behalf of Euratom. This Communication does not make concrete financial commitments on ITER ahead of the new Multiannual Financial Framework negotiations (MFF). Concrete financial commitments for the period post-2020 will be made at the time of budgetary authority decisions for the new MFF and will be finalized by heads of state and government in 2019.

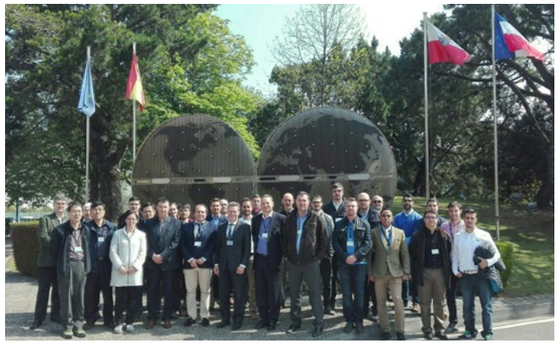
And the Institutional Award of the Catalan Association of Industrial Engineers goes to.. Fusion for Energy!

The Catalan Association of Industrial Engineers is one of the oldest professional associations in Catalonia, established back in 1863 with the objective to develop industrial engineering in the region. Today, it counts more than 15 000 members and associates, many of them distinguished professional engineers working home or abroad. Their "Diada de l'Enginyer" (Engineer's Day), which this year took place in Barcelona on 7 June 2017, is the annual occasion to reward achievements for the best in the profession both at individual and company/institutional level.

Next to promising young talent and seasoned professionals, the Association of Industrial Engineers of Catalonia decided to award the institutional prize to F4E and recognise it as a "world-class centre of excellence working on an extremely challenging engineering project such as ITER". The impact of the organisation on the wider industrial fabric of Catalonia has been considerable: more than 20 high-technology contracts have been awarded to local companies and more than 150 new jobs have been created. Most of all, F4E remains an important international meeting point for the development of fusion energy and an inspiration for scientists and engineers.

This distinction represents a great honour for Fusion for Energy, celebrating this year the 10th anniversary since its creation, and a great tribute to the high quality work and commitment of its staff to whom this prestigious award goes.

Vacuum Vessel partners share know-how and demonstrate commitment to ITER delivery



The participants shared technology and fabrication experiences in relation to the ITER Vacuum Vessel and are committed to ensuring its delivery

Committed to delivering the Vacuum Vessel contribution to the ITER project, over 30 experts from F4E, ITER IO, the Indian, Korean and Russian ITER Domestic Agencies, and European, Russian and Korean industrial partners came together in a Vacuum Vessel collaboration meeting held at the Spanish headquarters of Equipos Nucleares SA (ENSA) – a company working both for ITER IO and the AMW consortium (the European consortium consists of companies Ansaldo Nucleare S.p.A, Mangiarotti S.p.A and Walter Tosto S.p.A). Industry partners attending also included Hyundai Heavy Industries and MAN Diesel and Turbo, as subcontractors for the Korean and Russian ITER Domestic Agencies respectively.

Participants shared the technology and experience of fabrication of the ITER Vacuum Vessel, including the ports and the In-Wall shielding plates, and discussed the development pathway for fabrication issues. Special focus was also given to the new technologies for fabrication of the Vacuum Vessel sectors, especially welding, non-destructive examination (NDE) and dimensional measurement.

F4E Director, Johannes Schwemmer, emphasised the importance of valuable collaboration in ensuring delivery of the Vacuum Vessel. "At this crucial stage in Vacuum Vessel fabrication we count on all our partners' know-how in nuclear manufacturing."

After visiting the ENSA facilities, the Director added, "I am particularly impressed by the complete approach ENSA takes to nuclear quality, including having its own metrology and materials science laboratories. Even more impressive is ENSA's focus on innovation and its broad use of industrial robots specifically adapted to nuclear-grade welding".

King and Queen of Spain learn more about the JT-60SA and IFMIF/EVEDA projects

The King and Queen of Spain together with Dr J. Sanchez, Prof. M. Mori, Secretary of State C. Vela, Foreign Affairs Minister A. Dastis, and Ambassador G. de Benito.

During their recent state visit to Japan, Their Majesties King Felipe VI and Queen Letizia of Spain visited the National Museum of Emerging Science and Innovation (Miraikan) in Tokyo where they attended presentations about the bilateral scientific and technological projects between Spain and Japan that are currently underway.

During the event, which also was attended by Carmen Vela, Spanish Secretary of State for Investigation, Development and Innovation, Alfonso Dastis, Minister of Foreign Affairs of Spain, and Gonzalo de Benito, the Ambassador of Spain in Japan, the scientific relations in the field of JT-60SA and IFMIF/EVEDA – part of the Broader Approach agreement in which Spain through Laboratorio Nacional de Fusion - CIEMAT plays an important role – were highlighted. Dr Joaquin Sanchez, Director of Laboratorio Nacional de Fusion - CIEMAT and Chairman of F4E's Governing Board, and Professor Masahiro Mori, Managing Director of Directorate Fusion Energy Research and Development of the National Institutes for Quantum and Radiological Science and Technology (QST) presented the headway being made within the two projects and emphasised the fruitful collaboration between Europe and Japan.

"Their Majesties were impressed with the scientific and technological achievements we have made within the field of fusion", said Dr Joaquin Sanchez. "We are happy that these projects are being recognised for their progress".

Fusion takes the stage at the EU Sustainable Energy Week

The event is Europe's most important policy conference on energy. The 2017 edition featured more than 60 conference sessions exploring the latest thinking on sustainable energy policy, led by representatives of the European Commission, industry organisations, local authorities and NGOs.

SUSTAINABLE ENERGY WEEK
19-25 JUNE 2017
An initiative of the European Commission

The conference offered the opportunity to the more than 2 000 participants to discover innovative policies and projects for clean, secure, sustainable energy and build alliances for future cooperation. This year's conference took place in Brussels from 20-22 June.

For the first time, fusion energy was featured in the programme of the conference, highlighting the growing recognition of the important role it would be called upon to play in the sustainable energy mix of the future.

Fusion for Energy representatives organised a policy seminar on "Fusion: Clean, Safe, Unlimited Energy for the Future" and explained in detail what fusion is, how it works, the promises it holds and how far we still have to go to conquer this unique source of energy. The progress of the ITER project, the next big step on the road to fusion, as well as the economic and industrial benefits arising from investing in the development of fusion were also detailed.

In the debate that followed the presentation, participants said to be impressed by the potential of fusion energy in generating vast amounts of electricity in a safe and clean manner. It was noted that the arrival of fusion would not only signify unlimited energy for all, but would also mark the end of current geopolitical tensions linked to the location of the reserves of fossil fuels. Fusion can guarantee security of supply as the fuels required, sea water and lithium from the earth crust, are abundant and widely available everywhere on the planet. Finally, despite the fact that the horizon for commercially available fusion energy is still a few decades away, it was clearly recognised that its development remains important as it is the only known energy source which has the potential for industrial scale baseload energy to cover the ever-growing future energy needs.

"Clean Energy for All Europeans" was the theme for the 2017 edition of the EU Sustainable Energy Week and the policy seminar offered by F4E underlined the key role that fusion will have in this respect.

Fusion for Energy
The European Joint Undertaking for ITER and the Development of Fusion Energy

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