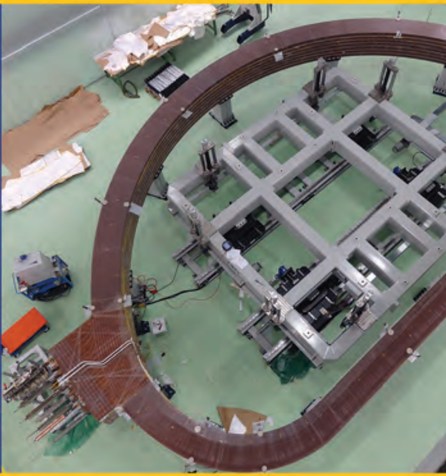
FUSION
FOR
ENERGY

ANNUAL REPORT **2015**



FUSION FOR ENERGY

Annual Report 2015

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FACT SHEET

Name:	The European Joint Undertaking for ITER and the Development of Fusion Energy or "Fusion for Energy" (F4E)
Objectives:	(a) Providing Europe's contribution to the ITER international fusion energy project; (b) Implementing the Broader Approach agreement between Euratom and Japan; (c) Preparing for the construction of demonstration fusion reactors (DEMO).
Location:	Barcelona, Spain
Established:	19 April 2007 for a period of 35 years
Founding Legal Act:	Council Decision No. 2007/198/Euratom of 27 March 2007 establishing the European Joint Undertaking for ITER and the Development of Fusion Energy and conferring advantages upon it, as last amended by Council Decision (Euratom) 2015/224 of 10 February 2015
Director(s):	Didier Gambier (1 October 2007 – 15 February 2010) Frank Briscoe (16 February 2010 – 15 August 2012) Hans Jahreiss (Interim Director from 16 August – 31 December 2012) Henrik Bindslev (from 1 January 2013 – 28 February 2015) Pietro Barabaschi (Acting Director from 1 March – 31 December 2015) Johannes Schwemmer (from 1 January 2016 – Present)
Governing Body:	Governing Board (Chair: Joaquin Sánchez, Chair (until 30 June 2015): Stuart Ward, Members: 28 EU Member States, Euratom and Switzerland)
Subsidiary Bodies:	Bureau (Acting Chair: Joaquin Sánchez, Chair (until 30 June 2015): Stuart Ward, seven Members) Administration and Management Committee (Chair: Cor Katerberg, 12 Members) Executive Committee (Chair: Lisbeth Grønberg, 13 Members) Procurement and Contracts Committee (Chair: Lisbeth Grønberg, 13 Members) Technical Advisory Panel (Chair: Joaquin Sánchez, 12 Members) Audit Committee (Acting Chair: Brian Gray, Interim Chair (until 30 June 2015): Stuart Ward, three Members)
Staff:	419 (252 Officials and Temporary Agents and 167 Contract Agents), as of 31 December 2015
2015 Budget:	EUR 457.11 million in commitment appropriations in the final budget EUR 493.08 million in payment appropriations in the final budget The entire F4E budget is devoted to the ITER and Broader Approach projects.
Budget Implementation:	100% in commitment appropriations (49% compared to the original budget) 99% in payment appropriations (82% compared to the original budget)
Operational Contracts:	79 signed for a total value of about EUR 326 million (73 launched)
Administrative Contracts:	150 signed for a total value of about EUR 6 million (five launched)
Grants:	Nine signed for a total value of about EUR 6 million (four launched)

Procurement Arrangements:	One new PA signed for the ITER Project – 17.31337 kIUA bringing the total to 967 kIUA out of a total of 1116.84 kIUA foreseen. Four new PAs for the Broader Approach – 8.52 kBAUA, plus amendments/adjustments of existing PAs, bringing the total to 467.66 kBAUA out of a total of 500 kBAUA foreseen.
ITER Credit Awarded:	39.51 kIUA during 2015
Meetings of Statutory Bodies:	Four of the Governing Board, six of the Bureau, two of the Administration and Management Committee, one of the Executive Committee, five of the Procurements and Contracts Committee, two of the Technical Advisory Panel and one of the Audit Committee

Foreword by the Chair of the Governing Board

It is an honour for me to introduce this eighth annual report of Fusion for Energy (F4E), the European Domestic Agency for the ITER project. F4E is in charge of the European contributions to this international experiment, aiming to demonstrate the scientific feasibility of fusion as a clean and inexhaustible massive source of energy. Europe, being the host of ITER located in Cadarache, France, plays a major role in the construction of this experiment since F4E is responsible for providing nearly half the ITER components.

ITER represents a tremendous technological challenge as the fusion plasma, which must be heated to over 100 million degrees, is only a few metres away from superconducting magnets operating at temperatures close to absolute zero. In addition, the fact that ITER is built under a broad international collaboration brings about governmental and organisational challenge that might be even greater than the technical challenges. ITER is indeed a joint effort of China, India, Japan, Korea, Russia, United States and Euratom, the latter participating as a single party and represented by the European Commission. Such a broad collaboration has the merit of bringing together more than half the world population with a common long-term goal. This was possible largely thanks to the in-kind contribution system, which allows all parties to use their own industries and R&D centres to develop valuable technologies. However, a broad collaboration has also a cost in terms of time and financial aspects: the ITER project is taking significantly more time and budget than originally estimated. The good news is that, even with such increase, the cost of ITER will remain a relatively minor fraction of what mankind spends in energy. One should consider what the actual cost is of only a few days of the global energy consumption. Although the benefit of an international collaboration is difficult to quantify, we have plenty of examples of how much the lack of collaboration could cost.

As mentioned above ITER has suffered overcosts and delays, which have been slowly building up for several years. In this respect 2015 could be considered the start of a turning point. In March the ITER Council confirmed Bernard Bigot as the new Director General (DG) of the ITER International Organization (ITER IO) and endorsed his action plan, empowering him to better manage the project. The action plan made provision for a Reserve Fund, which is allowing the DG to take decisions more rapidly when there are design changes and bear the associated cost, and a number of steps oriented to deeper integration between ITER IO and the Domestic Agencies (DAs): the creation of an Executive Project Board as the main steering body and more specific, project-oriented Integrated Project Teams. The DG presented a proposal for a new budget and schedule at the November ITER Council which was the result of an in-depth analysis of the whole project, including a detailed study of the assembly process. This proposal is being analysed by an external panel and it is expected that a final budget and schedule, taking into account the panel recommendations, will be agreed before the end of 2016.

On the technical side, the front line of the technical developments, many of them under F4E`s responsibility, is progressing at unprecedented speed. As this Annual Report shows, from the start to the end of the year a significant number of buildings have emerged, the most representative the assembly building, with its 900 ton roof which was lifted to its position with high accuracy in a single operation. The pictures in this report showing the status of a number of constructions in January and December provide graphical proof of this substantial progress. Other components like the Toroidal Field coils, where the radial plates and double-winding pancakes achieved dimensional accuracies beyond the most optimistic expectations, the Poloidal Field coils, with all the relevant contracts awarded and a significant level of tooling deployed in the construction hall, or the first wall panels, with the successful test of several prototypes under high energy flux, are also representative examples of the project progress which can be found in the present Annual Report together with many others. It is also worth to mention the completion of the Neutral Beam Test Facility Building in Padua and the arrival of the first Japanese components to this facility.

During 2015 a total of 73 operational procurement procedures were launched and 79 procurement contracts were signed for a value of about EUR 326 million, bringing the total value of the contracts and grants awarded since 2007 to nearly EUR 3600 million. Through these contracts F4E supports people in over twenty EU Member States and Switzerland who are working in about 300 European companies and about 60 R&D organisations engaged in cutting-edge R&D, design, manufacture and fabrication work.

F4E has also evolved in order to adapt to a more project-orientated organisation. After Henrik Bindslev's resignation as F4E`s Director at the end of 2014, the Head of the Broader Fusion Development Department, Pietro Barabaschi, was appointed by the GB as Acting Director, giving him a full empowerment to implement the necessary changes derived from ITER IO´s Action Plan of DG Bigot. Under the leadership of Pietro Barabaschi the collaboration between ITER IO-F4E has improved substantially and F4E has developed its own action plan in order to implement in a realistic way the new ITER IO guidelines. The Acting Director has also reinforced the structure of F4E by introducing a new department, "Project Management Infrastructure and Control" which will give crucial support to the organisation in a large and complex project like ITER.

The projects under the Broader Approach collaboration between Europe and Japan have also shown significant progress and are an element of encouragement for ITER, as they are on more mature phases of their development and the final completion is seen as a nearer term milestone. Regarding the JT-60SA project it is worth to mention the completion of the first Toroidal Field (TF) coil, being ready for cold testing, the delivery to Naka of the cryoplant and the smooth progress in the fabrication of the remaining TF coils, the cryostat, the superconducting current leads, power supplies and other systems. The IFMIF-EVEDA project is also showing a swift progress, with the commissioning of the injector on site, the delivery of the first radiofrequency modules, the completion of the medium energy beam transmission module and the diagnostic plate and, a very important milestone, the delivery of the radiofrequency quadrupole. Within the third project of the Broader Approach, the Helios Computer has reached maturity both in performance, with a 98% availability, and in scientific achievements by its users, who kept the device capacity busy at a rate of 90% on average. A final upgrade of Helios is planned for early 2016.

The Governing Board (GB) met four times in 2015, including an extraordinary meeting in early October to select the new Director. In this meeting the GB appointed Johannes Schwemmer, an electrical engineer with extensive experience in management of large industrial projects, as the new Director of F4E starting in January 2016. In its ordinary meetings the GB supported the action plan of the ITER IO DG as well as the accompanying one prepared by F4E and encouraged its implementation. In parallel, significant attention was paid to the budget and schedule issues, in particular the GB reassured its determination to keep the cost until 2020 within EUR 6.6 billion (2008 values) and requested the Director to implement the necessary strategies to remain within this limit. The GB also focused on specific elements which have been driving the cost increase, like the buildings, and welcomed the proposal by the Director to have an assessment of the buildings contracts done by an external expert.

In parallel, the yearly assessment requested by the European Council was carried out by the same team as the previous year which facilitated the GB to have a careful follow-up of the implementation of their previous recommendations. The GB welcomed the overall positive assessment, in particular, the significant improvement in the contract follow up at the supplier´s premises.

I would like to thank, first of all, my predecessor Stuart Ward, for his work as Chair of the GB during the first half of the year. Stuart who was an excellent Chair for nearly four years has set a very high standard on this job which is an inspiration for me. I must also thank the members of the Governing Board for their constructive work as well as the members of the Bureau, the Administration and Management Committee, the Technical Advisory Panel, the Audit Committee and the Procurement and Contracts Committee. I would like to remark my thanks to the Chairs of the subcommittees, in particular to the departing ones, Cor Katerberg and Lisbeth Grønberg.

During 2015 the responsibility of the European Commission in F4E was transferred from Directorate–General (DG) Research and Innovation to DG Energy, I would like to thank the outgoing team with Director-General Robert Jan Smiths, Director András Siegler, and Head of the ITER Unit Andrea Carignani di Novoli for their effort and support during the last years and welcome and thank the incoming team, DG Dominique Ristori, Deputy DG Gerassimos Thomas, Director Massimo Garribba and Head of ITER Unit Jan Panek for the enthusiasm and energy they have devoted to the ITER project and F4E during the first months in their new activity.

The real strength of every organisation and the origin of all its achievements lay in the daily work of its staff. This is particularly true for F4E and, on behalf of the Governing Board, I would like to thank all staff for their everyday commitment.

Joaquín Sánchez
Chair of the F4E Governing Board
13th June 2016

Foreword by the Acting Director of F4E

During 2015, Fusion for Energy (F4E) has continued to steadily progress in delivering Europe's contributions to the international ITER and Broader Approach fusion energy projects. Every year we are seeing more and more visible evidence of headway, notably at the ITER construction site in Cadarache where worksite teams have advanced on the first floor of the massive Tokamak complex, the very first European components reaching ITER, as well as progress in the area of superconducting magnets and the Broader Approach (BA) projects in Japan. Indeed, the steady progress and milestones achieved in all these areas are proof of the strength of the partnership between F4E, the ITER Organization (ITER IO) or Voluntary Contributors for the BA, as well as European industries and fusion laboratories.

In terms of progress on the ITER buildings, I am happy to report that the main civil works & finishing works contract for the Tokamak complex, Assembly Hall and surrounding buildings have progressed significantly. For example, works have advanced on the first floor of the Tokamak complex as well as in its core which is a very complex area because of the high density of reinforcement necessary to carry the heavy load of the ITER machine. In September 2015, the main steel structure of the Assembly Hall building was completed and the roof, which weighs 900 tons, was lifted in one piece in a single operation which lasted less than 24 hours. Construction activities progressed for the site services, radio frequency heating, cleaning and cryoplant facilities. Work is underway on close to a dozen individual construction sites on the platform.

For the superconducting magnets that will hold the hot plasma in ITER, a key milestone was achieved following the successful tests of the first-ever full-size Toroidal Field (TF) coil superconducting double pancake prototype, one of the main elements of the magnet. The industrial production phase is well underway. F4E has completed the TF cable production. Many of the main components for the TF magnets are in series production. The winding tooling has been delivered to the Poloidal Field (PF) building at the ITER construction site.

On other fronts, F4E, is dedicated to working together with the other three procuring ITER Domestic Agencies (India, Korea and Russia), and in tight collaboration with ITER IO in the framework of the Vacuum Vessel Project Team to improve manufacturing performance for this critical ITER component. Work on qualifying the welding processes is continuing and the first production welds have been completed for the first components.

In preparation for industrial manufacturing, the qualification phase for ITER's internal components is vital, as design choices are progressively validated through the fabrication and testing of semi- and full-scale prototypes. For the first-wall and divertor, the components being developed by F4E to protect the inside of the vacuum vessel from the hot plasma, progress has been made in the pre-qualification of these components. Thanks to successful tests under intense heat flux, F4E and its industrial partners have now completed the manufacturing of the Blanket First Wall semi-prototype.

The development of remote maintenance systems for ITER is an important area of F4E's work for which design, development and testing work is well underway. One of the highlights of 2015 in this field was the successful demonstration activities at ITER's Divertor Test Platform (DTP2) which shed new light on the performance of Remote Handling equipment. Also, in May 2015, European industry was able to benefit from one of the biggest robotics contracts in the field of fusion energy.

F4E will contribute to several heating systems which will heat the plasma in ITER to the necessary temperatures for fusion to occur. For the radio- and microwave heating systems much of this work is in the research, design and development stage but there have been promising developments with the 1MW continuous-wave (CW) gyrotron prototype for ITER where the manufacturing, assembly and factory testing was completed. For the neutral beam heating systems, the construction of the Neutral Beam Testing Facility (NBTF) in Italy continued at a steady pace. All the F4E components for SPIDER are being installed and commissioned. In particular, the SPIDER vessel has been positioned inside the bioshield, the SPIDER High-Voltage Deck (HVD) has been delivered and accepted, and the ion source power supply has been installed inside the HVD.

Another important contribution of F4E is the tritium plant, which will recover tritium used during the fusion process, and in 2015 F4E delivered the first European components – six water detritiation tanks – to ITER on its site in Cadarache.

Concerning the ITER diagnostic systems,

prototyping programmes for many diagnostics are up-and-running, addressing the feasibility, performance and manufacturability of a wide variety of components. Last but not least, steady progress was made in the development of the Test Blanket Modules.

The first Highly Exceptional Load (HEL) to travel along the ITER Itinerary in January – an 87 ton electrical transformer provided by the US – also became the first plant component to be installed in its permanent position on the ITER platform. Indeed, it is the result of a complex but successful coordination involving F4E, ITER's global logistics provider, ITER IO and the relevant French Authorities.

To deliver on our commitments, in 2015 F4E signed 79 operational contracts and nine grants to industries, laboratories and other organisations for a total value of just over EUR 330 million bringing the total value of contracts and grants signed to EUR 3.572 billion. At the same time, 77 new procurement or grant procedures were launched.

Moving to the Broader Approach projects, I am pleased to report that good progress was made during 2015 and that the overall level of progress as measured by a comparison of earned versus planned credit is at a level of 95%.

In 2015 a large number of important targets have been achieved in the Satellite Tokamak Programme (JT-60SA project): the fabrication of the Toroidal Field coils progressed at accelerated pace culminating with the delivery of the first complete TF coil for testing. In addition, the Quench Protection Circuit installation and commissioning in Japan was successfully completed exactly on schedule.

For the BA IFMIF/EVEDA project, the commissioning of the LIPAc (Linear IFMIF Prototype Accelerator) injector progressed steadily. The first two modules of the Radio Frequency (RF) power sources, including its High Voltage Power Supply, for the Radio Frequency Quadrupole (RFQ) were delivered and set up in Rokkasho, Japan.

With regards to the BA IFERC project, the cycle of projects using the Helios supercomputer continued their successful operation and the usage of the facility remained high (around 90%), and availability above 98%. Activities in DEMO R&D in materials and DEMO Design have continued, increasing the interaction between the two areas. The implementation of the ITER Remote Experimentation Centre (REC) activities is progressing well.

Throughout the reporting period F4E has been working closely with ITER IO which during 2015 came under the leadership of a new Director-General (DG), Bernard Bigot, and the other ITER DAs. The 2015 ITER Action Plan of DG Bigot which was endorsed by the ITER Council in March 2015 and the F4E Action Plan in the same month have resulted in key measures, including the creation of a new Reserve Fund in the ITER IO to compensate F4E and other DAs for the cost of changes and missing items compared to the project technical baseline, and the creation of Integrated Project Teams which enable members from F4E, ITER IO and other DAs to foster an even deeper collaboration and carry out more efficient and rapid decision-making. An Updated ITER Long Term schedule has been prepared that includes more realistic dates by taking into account better estimates for the duration of activities, including their financial and human resources needs with the main focus on achieving a First Plasma by the end of 2025. Well-defined milestones have been selected and are followed-up closely at ITER Council level to make sure that the project does not suffer any additional slippage. I take this opportunity to express my appreciation for the excellent spirit of cooperation I have enjoyed with DG Bigot and his management team.

In 2015 F4E implemented around EUR 460 million in commitments and EUR 495 million in payments (49% and 82% of the original budget). In commitments, the EUR 500 million reduction of Euratom's contribution diverted to the European Strategic Fund for Investments (ESFI) will be returned in 2018-2020. F4E has continued to recruit in 2015 and by year-end 419 staff were in post and the vacancy rate was 5.2%.

This is my first and last Annual Report as Acting Director of F4E, since on 1st January 2016 Johannes Schwemmer, took over the realm as F4E Director, appointed by the Governing Board. My time at the helm of F4E has been most engaging and one of the highpoints of my professional career. I would like to take the opportunity to thank Joaquín Sánchez, Chair of the Governing Board, Stuart Ward, Chair of the F4E Governing Board until 30th June this year, as well as the members of the Board and the other supervisory committees for the confidence they have placed in me. I have also appreciated the effective cooperation between F4E and the European Commission. During 2015, the portfolio of ITER has been transferred between the Directorate Generals for Research and Innovation to Energy. I would like to thank the Director-General for Research and Innovation and European Representative at the ITER Council during the first part of 2015, Robert-Jan Smits and his services, in particular, András Siegler, the Director of Energy and Andrea Carignani di Novoli, Head of Unit for ITER, as well as the Director-General for Energy and European Representative at the ITER Council during the second part of 2015, Dominique Ristori and his services, in particular, Gerassimos Thomas, Deputy Director-General, Massimo Garribba, the Director of Nuclear Energy, Safety and ITER, and Jan Panek, Head of Unit for ITER.

In conclusion, I would like to express my appreciation for the F4E staff for their skill, dedication and professionalism.

Pietro Barabaschi

Former Acting Director of Fusion for Energy
15th June 2016

Chapter 1

Introduction

Introduction

In face of the increasing global demand for energy and the economic, political and environmental risks of using fossil fuels, energy produced by fusion has the potential to make a major contribution to a diverse, sustainable and secure energy supply system in a few decades from now.

To advance fusion energy research close to the point at which the first demonstration commercial reactor could be constructed, Europe has entered into two international agreements:

- Agreement for the Establishment of the ITER International Fusion Energy Organization (the ITER Organization) for the Joint Implementation of the ITER Project (with China, Korea, India, Japan, the Russian Federation and the USA);
- Agreement for the Joint Implementation of the Broader Approach Activities in the Field of Fusion Energy Research (with Japan).

The European Joint Undertaking for ITER and the Development of Fusion Energy or Fusion for Energy (F4E) has been set up to provide Europe's contribution to these two projects and, in the long term, to prepare for the construction of a demonstration fusion reactor and material test facilities.

The signing of the ITER Agreement on 21st November 2006 at the Élysée Palace in Paris. Present are French President Jacques Chirac, European Commission President José Manuel Barroso and some 400 invited guests including high-level representatives from the ITER Parties and European Member States (courtesy of ITER Organization)

What is Fusion?

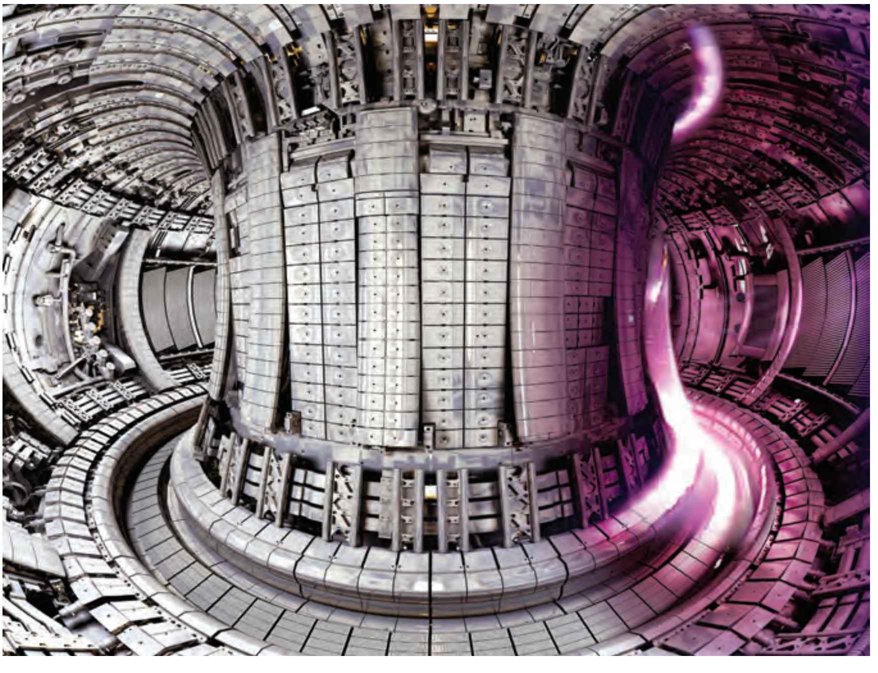
Fusion is the process that powers the sun and other stars and makes life on Earth possible. As the name suggests, the process involves fusing together light atoms to make heavier ones and occurs at the extreme pressures and temperatures caused by the gravity in the sun. During fusion reactions a small amount of mass is converted into energy, in accordance with Einstein's well-known $E = mc^2$ equation.

To make fusion happen on earth, several approaches have been explored. One of these involves heating a gas to very high temperatures (100-150 million degrees centigrade) so that it becomes a plasma which can conduct electricity. Magnetic fields can then be used to contain this plasma long enough for fusion to occur.

In fusion experiments, the magnetic confinement of the hot plasma is achieved using a doughnut-shaped vessel with magnetic coils. Since the 1950s scientists and engineers from all over the world have been carrying out research to assess the most promising approach and the tokamak configuration has emerged as a leading contender.

The merits of fusion include the abundance of the basic fuels (deuterium and lithium), the absence of greenhouse gas emissions, a very low impact on the environment with no long-lasting radioactive waste and finally the inherent safety of fusion reactors, where no meltdown or runaway reactions are possible.

Europe is at the forefront of fusion research, largely due to the integration of national fusion programmes into a single co-ordinated Euratom fusion research programme, including the construction and operation of the Joint European Torus (JET), the world's leading fusion device now under the umbrella of the EUROfusion consortium agreement (formerly the European Fusion Development Agreement (EFDA).



Inside JET's doughnut-shaped vacuum vessel, plasmas (overlaid image) are confined using magnetic fields and heating to enormous temperatures to create fusion reactions (courtesy of EUROfusion)

What is ITER?

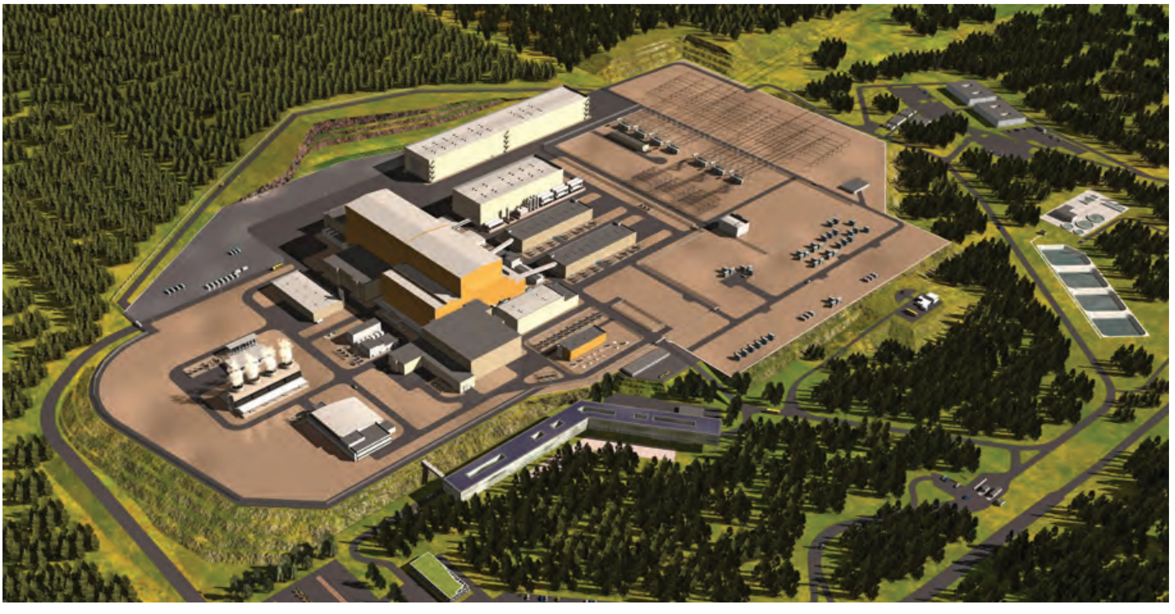
While JET and other tokamak experiments have succeeded in producing significant amounts of fusion power for short periods, none so far are capable of demonstrating fusion on a scale that would be needed for a reactor and a number of technologies that are needed to allow it to generate part of its own fuel and produce power on a more continuous basis.

ITER – "the way" in Latin – is the next major project in tokamak fusion research and is about twice as large as any existing fusion experiment today. Its objective is "to demonstrate the scientific and technological feasibility of fusion energy" and is being constructed at Cadarache in the south of France.

With seven parties participating in the project (the European Union including Switzerland, Japan, China, Korea, the Russian Federation, India, and the USA), ITER is one of the largest international scientific projects of its kind and brings together countries representing over one half of the world's population.

ITER aims to produce a significant amount of fusion power (500MW) for about seven minutes, or 300MW for 50 minutes. For the first time it will be possible for scientists to study a "burning" plasma – this is when the plasma is mostly heated by fusion reactions rather than by externally applied heating. It will also demonstrate many of the key technologies needed for future fusion reactors.

The ITER Organization is responsible for the construction, operation, exploitation and decommissioning of the ITER device. The Director General of the ITER Organization is appointed by the ITER Council which also supervises the overall activities of the ITER Organization. The European Commission represents Europe (Euratom) on the ITER Council.



An artistic impression of what the 180 hectare ITER site will look like once it is constructed. The yellow building which houses the fusion reactor rises 60 metres above ground level (courtesy of the ITER Organization)

What is the Broader Approach?

In February 2007, Europe and Japan signed the Broader Approach Agreement. This aims to complement the ITER project and to accelerate the realisation of fusion energy by carrying out R&D and developing some advanced technologies for future demonstration fusion power reactors (DEMO). Under the umbrella of the Broader Approach Agreement, three projects are being implemented in Japan:

- Producing a preliminary engineering design of the International Fusion Materials Irradiation Facility (IFMIF) with validation of the prototypes for the key subsystems – this facility is needed to test materials under the harsh conditions expected inside fusion power plants. This will allow the materials to be optimised so as to minimise their long-term radioactivity and retain their structural properties. The work is being carried out at Rokkasho in Japan;
- Constructing and operating a Satellite Tokamak (also known as JT60-SA) – this is a smaller version of the ITER project which will serve as a test bed to prepare for operating ITER and carry out research for future demonstration reactors. The project is being carried out by upgrading an existing fusion experiment located in Naka, Japan, in particular by using superconducting magnets;
- Establishing the International Fusion Energy Research Centre (IFERC) with the purpose of coordinating a programme of design and R&D activities for future demonstration reactors. Using a new supercomputer it is intended that large-scale simulation experiments on fusion plasmas will be carried out. Activities to develop remote experimentation techniques will also be performed. This work is being carried out at Rokkasho in Japan.

To develop synergy with its activities related to ITER, it was decided that F4E should also be the Implementing Agency of Euratom for the Broader Approach. The resources for the implementation of the Broader Approach will be largely provided by several participating European countries (Belgium, France, Germany, Italy, Spain and Switzerland).

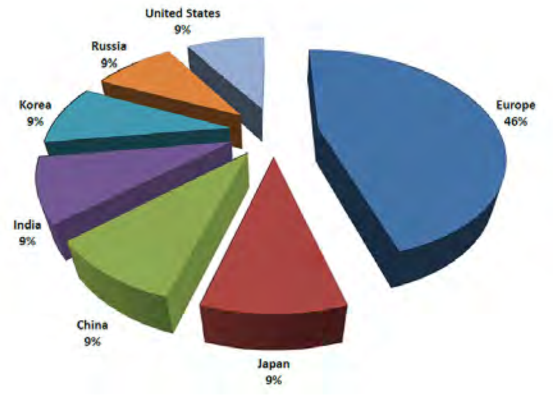
Fusion for Energy's Role

ITER Procurement Sharing

ITER is being constructed at Cadarache in the south of France. Europe, as the host party, and France, as the host state, have special responsibilities for the success of the project. Europe supports 45% of the construction cost and 34% of the cost of operation, deactivation and decommissioning of the facility as well as preparing the site.

Around 90% of the ITER project is built by in-kind contributions. To this end the components that make up ITER have been divided into 85 procurement "packages" which are distributed among the seven parties to the ITER Agreement to achieve the agreed level of contribution from each of them.

F4E is the European Domestic Agency (DA) for ITER and provides, on behalf of Europe, components to ITER that amount to five-elevenths (see pie chart) of the overall value of the project.



Sharing of the contributions to ITER by each of the ITER Parties

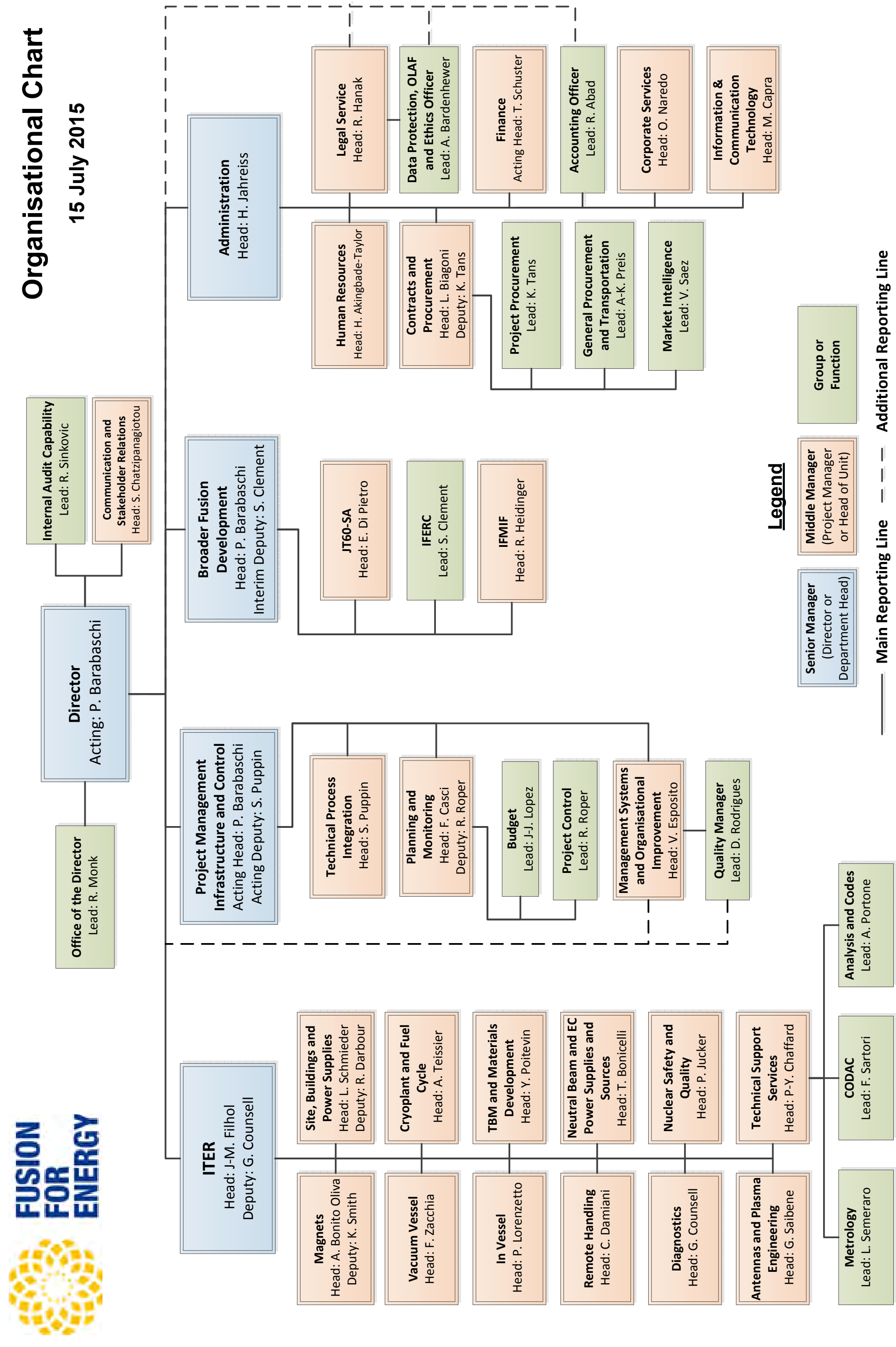
How we operate

F4E provides the EU's direct financial contribution to ITER's own running costs and the in-kind contributions of components. The typical process for providing in-kind contributions to ITER is as follows:

- If there is research, design, prototyping or other preparatory work to be done before an ITER component can be manufactured, ITER may issue a request known as an ITER Task Agreement (ITA) to ITER Domestic Agencies (DAs) (including F4E) to do the work;
- On the basis of the specifications in the ITA, F4E contracts out work (usually to European Fusion Laboratories (EFLs)) using grants which support a proportion (usually around 40%) of the costs to carry out the work;
- Assuming the work is completed in accordance with the ITA and to the satisfaction of the ITER Organization, F4E will be awarded a certain amount of ITER credit in recognition of the contribution that has been provided;
- Once the design of a component is sufficiently mature, an agreement called a Procurement Arrangement (PA) is usually concluded between F4E and the ITER Organization setting out what has to be provided and by when;
- On the basis of the specifications in the Procurement Arrangement, F4E starts a procurement procedure for industries in Europe, and sometimes also outside, to competitively bid for the work. F4E contracts with the tenderer that provides the best offer in terms of quality and/or price;
- Assuming the component is fabricated in accordance with the Procurement Arrangement and to the satisfaction of the ITER Organization, F4E will be awarded a certain amount of ITER credit in recognition of the contribution that has been provided.

In the case of the Broader Approach, the contributions to the projects are mainly provided on a voluntary basis by some EU Member States and Switzerland. Nevertheless, F4E concludes Procurement Arrangements with Japan and at the same time agreements of collaboration to specify what is to be provided and by when. F4E has also supported design activities, in particular, for the Satellite Tokamak.

Our Organisation



Our Management Team

Pietro Barabaschi

Pietro Barabaschi, an Italian national, was Director of F4E during 1st March to 31st December 2015. He has been Head of the Broader Fusion Development Department at Garching since 2008 and European Project Manager for the JT-60SA Project. An electrical engineer, Dr Barabaschi started his career at the JET Project. Later, in 1992, he joined the ITER Joint Central Team, San Diego Joint Work Site and by 2006 he was the Deputy to the Project Leader as well as Head of the Design Integration Division of the ITER International Team at the Garching Joint Work Site.

Jean-Marc Filhol

Jean-Marc Filhol, a French national, has been Head of F4E's ITER Department since 1st August 2011. An engineer with a PhD in nuclear instrumentation, Dr Filhol has spent the major part of his career in the field of particle accelerators. He was most recently Director of the Accelerators and Sources Division as well as Deputy Director General at SOLEIL, a third generation synchrotron radiation facility built near Paris, France.

Hans Jahreiss

Hans Jahreiss, a German national, has been Head of F4E's Administration Department since 1st July 2011. With a Doctorate in Law and Assessor Juris, Dr Jahreiss was most recently the Administrative Director of Eurojust, the European Union's judicial cooperation body. Before that, he was the Head of Administration at the European Organisation for Astronomical Research in the Southern Hemisphere (ESO) in Garching and Santiago de Chile.

Johannes Schwemmer

Johannes Schwemmer, a German national, is Director of F4E since 1st January 2016. He has a proven track record in international collaboration, project management and business strategy and has been working in the fields of information, telecommunications and business technology for more than 25 years. Before taking up the post as F4E Director, Mr Schwemmer was a partner at Antevorte, a German consultancy specialising in performance management. Previously he worked at Unify GmbH & Co. KG, a global market leader in unified communication solutions present in 100 countries, where he held different positions as Vice-President for Global Project Management and Service Optimisation, and Vice-President for Global Training. Earlier in his career he worked at Siemens Business Services, as Vice-President for Risk Management and Strategic Alliances Management.

Chapter 2

Our Achievements

ITER

Introduction

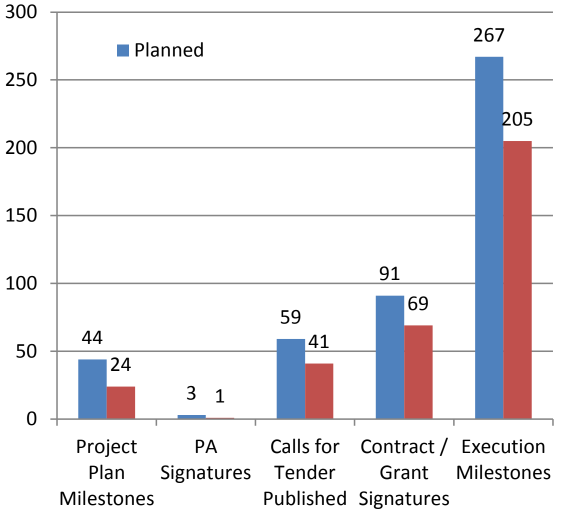
F4E activities in 2015 were carried out in line with the approved Work Programme 2015 and the amendments adopted by the Governing Board.

The F4E Detailed Work Schedules (DWS) contain the planning of the operational activities to be carried out. The DWS is submitted on a monthly basis to ITER IO and it is then integrated with the schedules transmitted by the other Domestic Agencies (DA). The result is then provided to F4E to assess the impact of the schedules of the other DAs on the own activities. The progress of the project is measured through agreed milestones and it is reviewed at monthly meetings.

In 2015 F4E signed one Procurement Arrangement for a total value of 17.3 kIUA. In addition, credits spread over 12 PAs and totalling 39.5 kIUA were received; five ITER Task Agreements (ITAs) were formally closed with the relevant credit notifications being paid in either Euros or Credit, whilst a further two ITAs were subject to interim payments, also in either Euros or Credit.

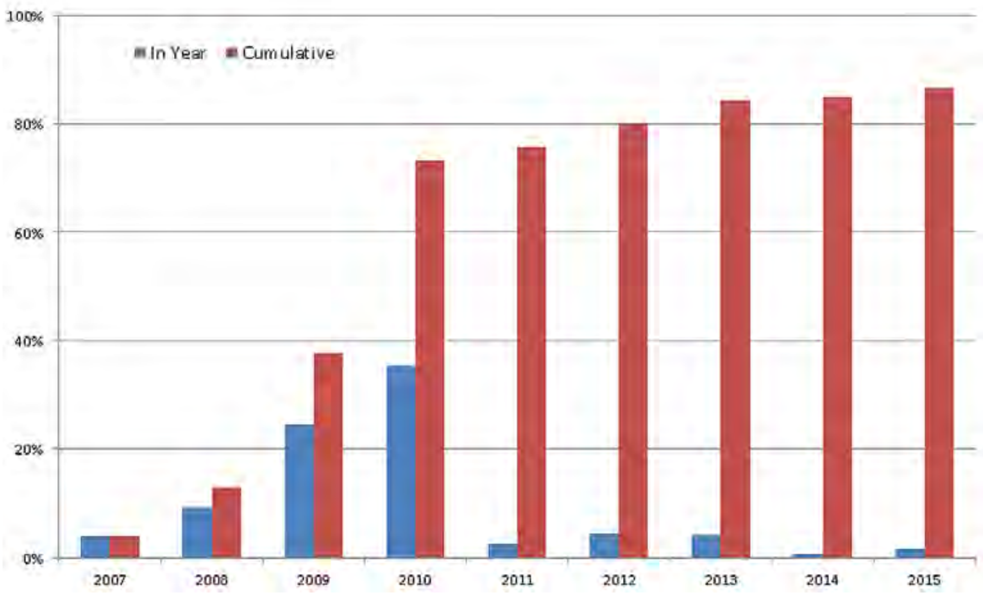
Key Performance Indicators

To quantitatively assess the progress made by F4E, a number of Key Performance Indicators (KPIs) are used: Project Plan Milestones, PA signatures, Calls for Tender published, Contract Signatures, and Contract Execution Milestones. A comparison of the planned and achieved milestones by the end of 2015 for the above KPIs is shown below.



	Milestones		
	Planned	Achieved	Achieved / Planned
Project Plan Milestones	44	24	55%
PA Signatures	3	1	33%
Calls for Tender Published	59	41	69%
Contract / Grant Signatures	91	69	76%
Execution Milestones	267	205	77%

Status of Key Performance Indicators until the end of December 2015



ITER Procurement Arrangements (% of total concluded in value)

The above graph shows the progress in the signature of the Procurement Arrangements between EU and ITER Organization (ITER IO) defining the terms for the procurement of the in-kind components. More than 60% of them, corresponding to about 88% of the total in value, were signed.

Project Management and Scheduling Activities

In 2015 the F4E Planning & Monitoring Unit has continued to provide an extensive transversal support to other F4E Units; in particular with respect to scheduling and project management, including costing, risk and monitoring tasks.

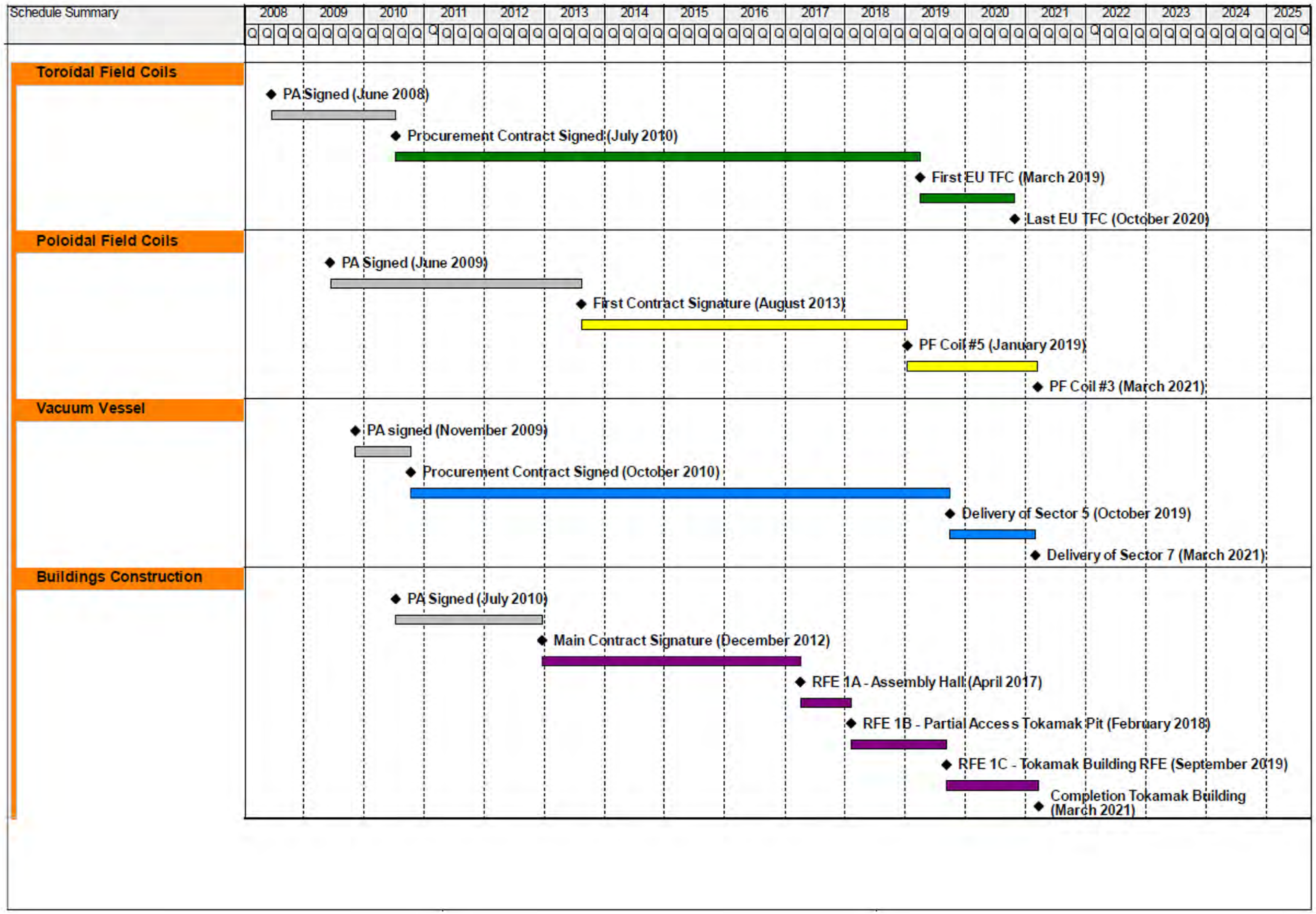
As far as planning activities are concerned, F4E has maintained and further developed its schedules based on both project development and input from its suppliers. Detailed Work Schedules (DWS) have been regularly updated and submitted to ITER IO at the beginning of each month to allow ITER IO to carry out an overall integration of the data. Input was provided to management concerning the progress of the activities and monthly monitoring meetings with the F4E Senior Management have been organised. Programmatic documents (i.e. Work Programmes, budgetary details, Resource Estimates Plan and the Project Plan) have been prepared and submitted to the F4E Committees for their review and approval.

In the area of export control; support was provided both to ITER and Broader Approach Departments to identify and deal with dual use items. Regular contacts have taken place with the Spanish Authorities on this topic.

Project Management support was provided for the preparation of the Procurement Arrangements and the management of Task Agreements with ITER IO. Programmatic documents have been prepared for presentation to the supervising committees as well as regular reports to show the progress in the implementation of the work. Cash contributions to both ITER IO and Japan have been managed. Budgetary matters including the management of commitments, payments and credits have been carried out and regular interactions with F4E stakeholders have taken place to monitor the implementation of the activities (i.e. calls for funds, regular reporting of status).

The project planning and monitoring systems at F4E have been improved, both in quality and in the variety of available reports. A formal change control procedure now allows unplanned milestones to be taken into account into the F4E baseline. The use of the F4E Integrated Reporting System has increased. More standard reports were created and the data quality was further improved. Data are regularly extracted to feed reports both for internal and external use.

Overall Schedule for the European In-Kind Contributions to ITER



Site, Buildings and Power Supplies

F4E is responsible for the in-kind procurement of the site infrastructure and all concrete and steel frame buildings and power supplies. This includes the Poloidal Field coil winding facility, Architectural and engineering services, the Tokamak excavation, the supply of anti-seismic bearings for the Tokamak Complex, the construction of all buildings, and the installation of pulsed power and steady state power supplies. The building construction makes up the largest part of the Buildings, Infrastructures, and Power Supplies (BIPS) in-kind contribution.

Executive Summary

The main highlights during 2015 are as follows:

- Establishment of the Buildings, Infrastructure and Power Supplies Project Team (BIPS PT) in order to promote closer collaboration between F4E and ITER IO in this area. Consisting of 65 members of staff from the two organisations, F4E has contributed with 38 members of staff.

- Tokamak Building – Cask Transfer Lift & Tokamak Cranes:

  o The Final Design and Construction Design for the two 750 ton cranes for the Tokamak assembly were approved. The Final Design Review for the 120 ton capacity Tokamak cargo lift was approved, and Construction Design was started; Fabrication of girders (support beams) of the two 750 tons cranes was almost completed by the end of 2015 by the contractor company Reel at the ASTURFEITO plant.

Crane 750 t first girder, stored at the factory location before assembly and squaring

- One of the major and biggest contracts for the BIPS Project Team, the main civil works & finishing works contract for the Tokamak complex, Assembly Hall and surrounding buildings has progressed significantly:

  o Works have progressed on the first floor of the Tokamak Complex;
  o Works have started in the Bioshield area (the core of Tokamak building) which is a very complex area because of the high density of reinforcement necessary to carry the heavy load of the ITER machine. Works have also started on the second floor of the Diagnostic building;
  o Works on excavation, foundations and galleries (underground works) was started for the Radio Frequency Heating building, Cleaning Facility building, and Cryoplant buildings;
  o The main steel structure of the Assembly Hall building was completed and the roof has been lifted in one piece (900 tons) in one operation of less than 24 hours;

One of the trolleys of the 750 t North crane during the assembly phase at the factory

  - o Civil works and main steel structure were completed for the Site Services building;

- Another of the major BIPS contracts, which concerns Mechanical, HVAC, Electrical and Handling Equipment supply and installation for the Tokamak complex, Assembly Hall and surrounding buildings has delivered further positive developments:

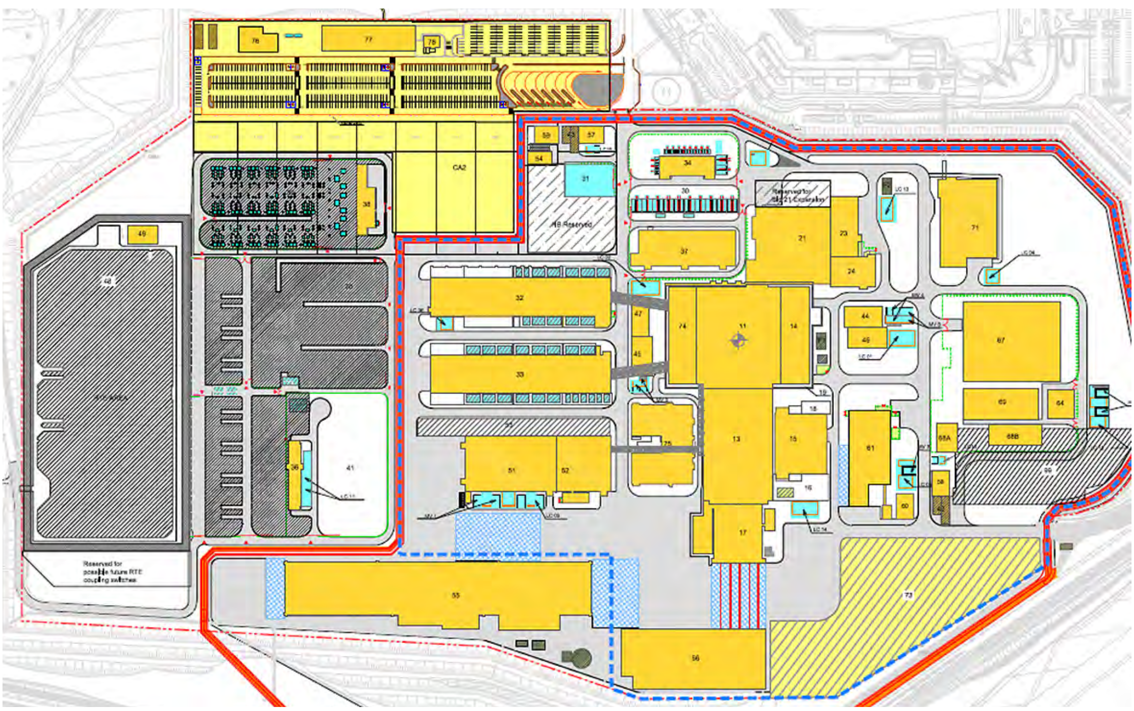
  - o Final Design Reviews were held and closed with satisfactory conclusions for most of the conventional buildings and have progressed for the other buildings and structures;
  - o Construction design of several buildings has started: primarily with the Services building and the Assembly Hall building.

- Design & Build for Magnet Power Conversion buildings and Reactive Power Control building: Construction Design Review has started in 2015. The soil has been treated in order to prepare for the commencing of the foundation building;

- Electrical Power Distribution: The Electrical Distribution building (housing all the 22kV SSEN distribution equipment) Final Design Review was finalised, and the installation of the SSEN 400kV/22kV transformers was completed;

- Design & Build for Cold Basin & Cooling Towers, Pumping stations and Heat exchangers: Construction Design for the underground part of Cold Basin and Cooling Tower Building, an important component of the ITER Cooling Water system, was approved by ITER IO.

- Site Infrastructure Works. This important contract (it will deliver all necessary infrastructures, galleries, drainage, roads, fences, lighting for the full ITER site and thus will ensure the physical links between all buildings and infrastructures of ITER) has been signed at the end of 2015.



Overview of ITER Construction site buildings and tender batch (TB) layout

Work Progress

Buildings

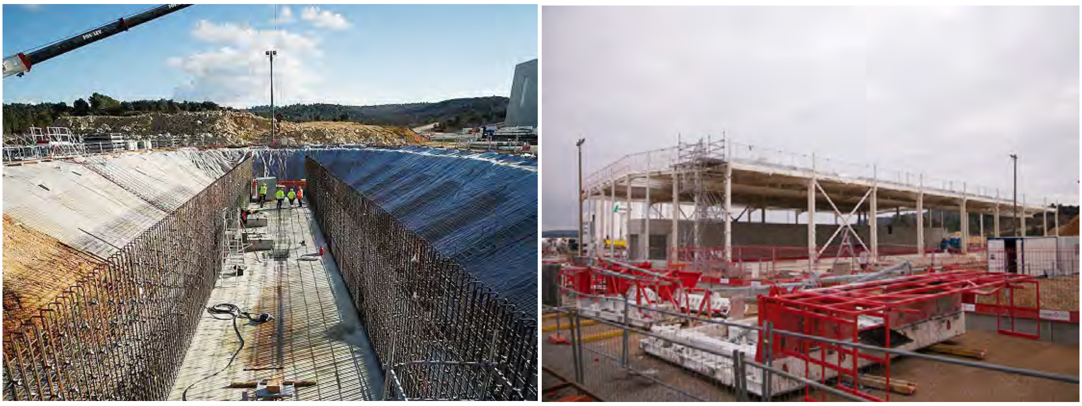
Works were carried out by the VFR consortium, consisting of VINCI Construction Grands Projets, Ferrovial Agroman, Razel-Bec, Dodin Campenon Bernard, Campenon Bernard Sud-Est, GTM Sud and Chantiers Modernes Sud.

The Assembly Hall building construction works have progressed in 2015: the primary steel structure has been completed, the roof structure has been erected, and cladding operations have started.

The Assembly Hall building in January 2015 and in December 2015

Excavation and foundation works for the Radio Frequency Heating building have started. The slab of the Cleaning Facility building was almost completed. The foundations of the Cryoplant buildings have started. The civil works of the Site Services building will be completed shortly.

The Cryoplant buildings in March 2015 and in December 2015

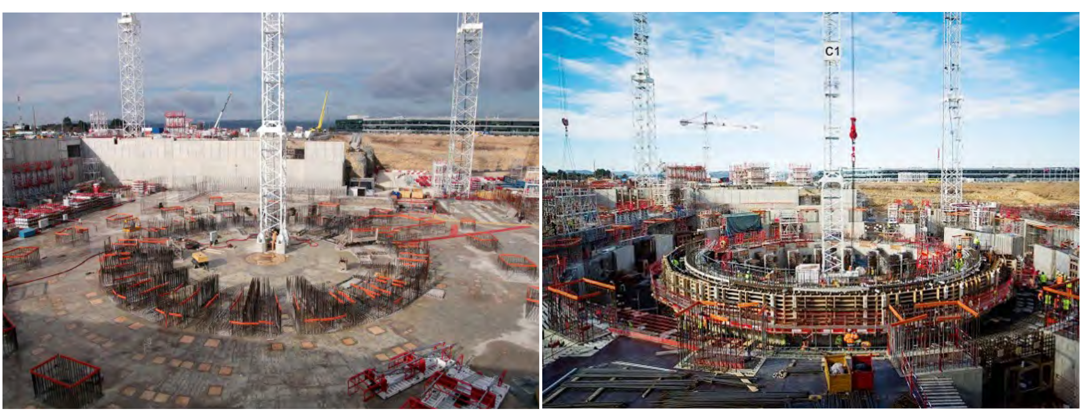


The Site Services building in January 2015 and in December 2015

The Diagnostics building in January 2015 and in December 2015

Within the Tokamak complex, the works in the second floor have started in the Diagnostics building. A full-scale mock-up of the bioshield walls was made in order to anticipate the constructability issue and to prove that the design was reliable. Reinforcement of bioshield first floor walls (first stage) in the core of the Tokamak was completed, and the first step pouring of bioshield walls of the Tokamak building was achieved successfully.

The construction design up to the fourth floor, was developed by the Architect Engineer, Engage, approved by ITER IO and instructed to VFR Consortium, which has allowed the Civil Works contractor to have a good overview and good visibility on the future works allowing organising the worksite activities in an optimal manner.



The Tokamak building in January 2015 and in December 2015

Power Supplies

Electrical Power Distribution: During the year, several activities linked to the installation and assembly of the first electrical components delivered by the US Domestic Agency (US-DA) (400kV/22kV power transformers) were completed. This was noteworthy achievement as these components are the first to be delivered from a different ITER Domestic Agency and installed by F4E.

The Transformers' area in March 2015

The installed transformers in August 2015

Transversal Support

F4E has been able to make much progress in the area of BIPS in part because of its strong support in terms of engineering company contractors:

- Architect engineer (ENGAGE ~270 staff - engineers, technicians, CAD designers, schedulers, architects, fire specialists etc.) - Scope: Studies, design, scheduling, evaluation of contractors, technical monitoring of construction contracts;
- Support to the owner (ENERGHIA ~30 staff) - Scope: Daily support to F4E in monitoring contracts (including the review of the design and support in construction supervision);
- Health, safety and legal inspection services (APAVE ~10 staff) - Scope: Compliance to health and safety requirements, to French and European construction norms, and access to the site.

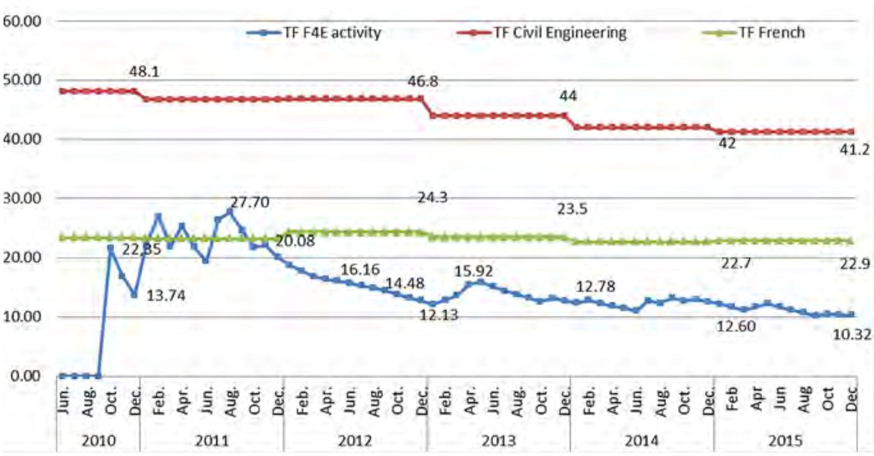
Procurement Activities

Several procurement procedures were managed successfully in 2015, for example the contract for site infrastructure works including the execution, design, procurement and installation of the following sections (Service Trenches, Precipitation Drainage, Precipitation Drainage, Industrial Water drainage, Sanitary Water drainage, Special foundations earthling grid, Roads & Parking & Laydown Areas, Non-Nuclear Fence, and Outdoor Lighting Equipment) and Geotechnical survey. This allows to have all major contracts of the initial phase signed to deliver the F4E contribution to ITER according to plan.

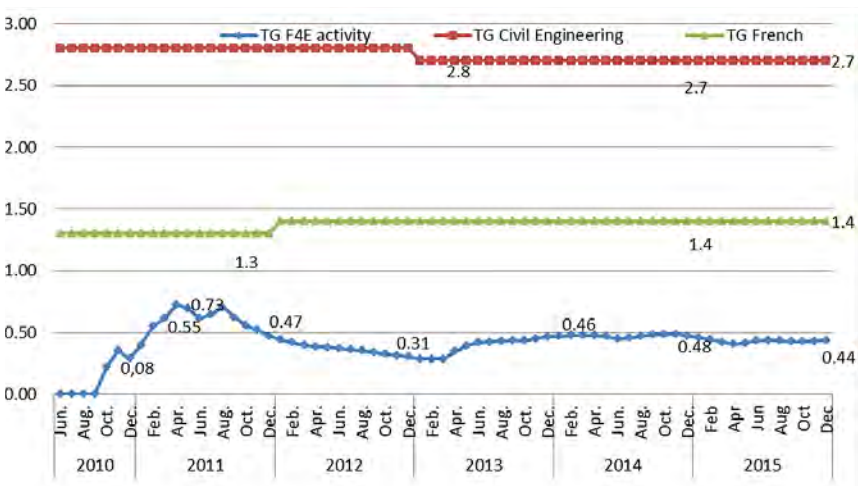
Health and Safety on the ITER Site

Health and safety management of the on-site activities at the ITER site is of paramount importance. During the year, around 950 workers (on average) were employed in the construction and design activities. Health and safety indicators are evaluated on a monthly basis. The following graphs represent the results for mentioned indicators at the ITER worksite in comparison with the data for French companies and civil engineering in general for the same period.

As demonstrated by the graphs, both the frequency and severity indicators for work on the ITER site have been consistently well below both of the average levels since 2012. Health and safety is of upmost importance and F4E strives to ensure that the low rates will be maintained.



Graph frequency rate (number of accidents with lost working days / total working hours x 1,000,000)



Graph severity rate (number of lost working days / total working hours x 1,000)

Overall, during 2015, the Buildings, Infrastructures, and Power Supplies Project Team has achieved significant visible progress of works on the ITER construction site.

Magnet Systems

In terms of the scope of the supply for which F4E is responsible:

- Ten Toroidal Field (TF) coils and 20% of the Nb_3Sn conductor to be used in the TF coils (89.74 kIUA);
- Five Poloidal Field (PF) coils and 11% of NbTi conductor for the PF coils (40.86 kIUA);
- Nine fibreglass composite pre-compression rings (0.6 kIUA);
- Toroidal Field conductor and Poloidal Field conductor (54.6188 kIUA).

Executive Summary

In the area of the Magnets significant progress has been made during 2015 of which the highlights include:

Conductors

- Completion of the Toroidal Field cable production;
- Successful testing of TFEU10, TFEU12 and TFEU13 samples at the SULTAN test facility;
- Fabrication of eight 760 m unit lengths of Toroidal Field conductors;
- Fabrication of the following Poloidal Field conductors: four 400 m PF1 and six 720 m PF6 conductor lengths.

Toroidal Field Coils

- Signature of the contract for the cold test of the winding packs and the insertion of ten TF coils into the TF coil structures;
- Series production of the 70 radial plates and of the 70 Double Pancakes (DPs) is well underway:

  o 38 Radial Plates completed and delivered to the winding pack supplier;
  o Winding of 40 DPs completed;
  o Heat treatments of 36 DPs completed;
  o Transfer & insertion of 30 DPs completed;
  o Turn Insulation of 27 DPs completed;
  o Cover Plate laser welding of 21 DPs completed;
  o Impregnation of 12 DPs completed.

- Series production of ten Winding Packs:

  o Stacking of DPs for the first Winding Pack has started.

Poloidal Field Coils

- Delivery of the winding tooling to the PF Building at the ITER site;
- Start of the contract for the Impregnation and Additional Tooling;
- Start of the contract for the Manufacture and Cold Test;
- Completion of the Call for tender for the Cold Test Facility;
- Start of qualification activities in Cadarache, France for PF5 and ASIPP (China) for PF6.

Pre-Compression Rings

- Completion of test of second 1/5 scale qualification ring;
- Analysed results from test and understood causes for failure to meet specifications;
- Redefined qualification strategy with ITER IO. Qualification activities started in February 2015.

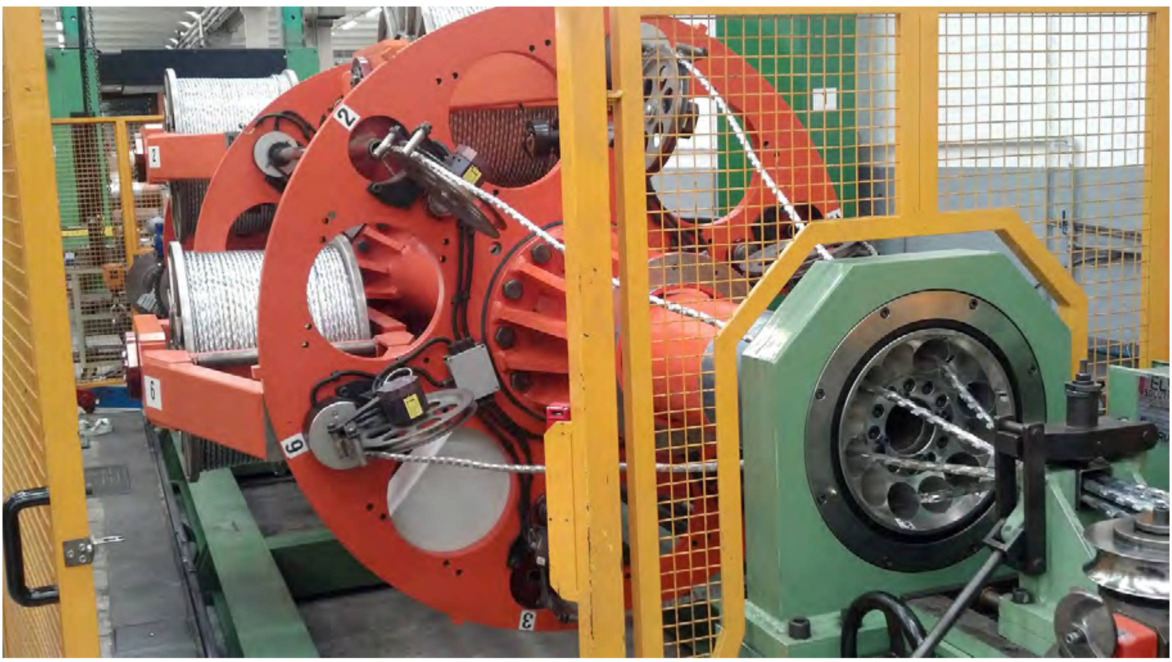
Progress Report on the Conductors

For the conductor, the industrial production phase is well underway, in particular:

- The full fabrication of the 30 cables for the Toroidal Field conductor has been completed in 2015;

- The SULTAN testing of the Pre-Production Phase (TFEU10) and Production Phase F4E TF conductor lengths (TFEU12 and TFEU13) was successfully performed at CRPP. Those tests confirmed the suitability of the F4E Toroidal Field conductor lengths made with the F4E-OPE-005-02 superconducting strand and further confirmed the regularity of the performance of the conductors made with the F4E-OPE-005-01 superconducting strand;

- The jacketing of the Toroidal Field and Poloidal Field conductors, as well as the JT-60SA conductor is proceeding well. In particular the fabrication of the JT-60SA conductor lengths has been completed in 2015. In addition, all the ITER TF conductor lengths but one have been manufactured. The last conductor length will be fabricated in early 2016. Concerning the PF conductors, 50% of the lengths needed for PF1 and PF6 coils have already been fabricated.



Fifth and last stage of Toroidal Field conductor cable fabrication at Tratos/ICAS

Progress Report on the Toroidal Field Coils

During 2015, the Japanese Domestic Agency (JA-DA) has declared a delay of up to eight months in the delivery of the coil structure to be used for the EU TF coils. This has obliged us to reduce speed on some of the activities in order to minimise EU suppliers cost claims. If we had kept the same production speed, a number of DPs and Winding Packs would have been completed up to seven months before their utilisation, with very large extra costs for storage and claims from the supplier. As a consequence, we have tuned the production speed in order to have such components in line with the arrival of the Japanese coil cases.

In spite of this challenge, the progress on TF coils has been very satisfactory.

Concerning the production of the Toroidal Field coils in 2014, F4E completed the follow-up of major milestones along with managing the main contracts and providing support to the industry. The following progress is highlighted:

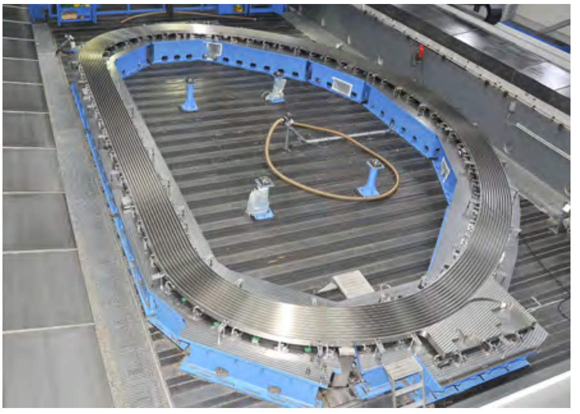
- Follow-up of the contract for manufacturing of 70 Radial Plates (signed in December 2012) and related activities. This included:

    o Successful completion and delivery of 38 Radial Plates. 17 have been produced by CNIM and 21 by SIMIC;

    o Accuracies obtained so far are very good, in particular considering the dimension of the Radial Plates: planarity of the order of 1mm, profile accuracy of the order of +/-0.5mm and tolerances on the position of the groove within 0.15mm with respect to the external profile.

- Follow-up of the contract for manufacturing of ten Toroidal Field winding packs (signed in July 2010) and related activities. This included:

    o Successful completion of the winding of 40 series production DPs using so far EU, the US Domestic Agency (US-DA) and the Chinese Domestic Agency (CN-DA) internal Tin and Russian and EU bronze route conductor. During the winding of these DPs, it has been possible to consistently maintain an accuracy of the conductor position of few tens of parts per million, more than adequate to ensure a secure fitting in the Radial Plate grooves;



Machined Radial Plate at the CNIM site (Courtesy of CNIM)

The three big sectors of the Radial Plate are being welded in the welding frame at the SIMIC site (Courtesy of SIMIC)

TF conductor, wound respecting strict geometrical tolerances in ASG, La Spezia (Courtesy of ASG)

- o Successful completion of heat treatment of 36 production DPs. The DPs are heat treated in groups of two or three. So far the length change of the different conductors during the heat treatment has been quite uniform and in line with the ones measured during the heat treatment trials;

- o Successful completion of insertion into Radial Plate groves of 30 heat treated series production DP. Thanks to the excellent accuracy achieved both during winding/heat treatment and during radial plate machining, the insertion process has gone very smoothly;

- o Successful completion of turn insulation on 27 series production DPs;

- o Successful completion of cover plate laser welding on 21 series production DPs;

- o Successful impregnation of 12 series DPs with VPI process;

- o DP stacking of the first Winding Pack, including inter-DP joint soldering has started.

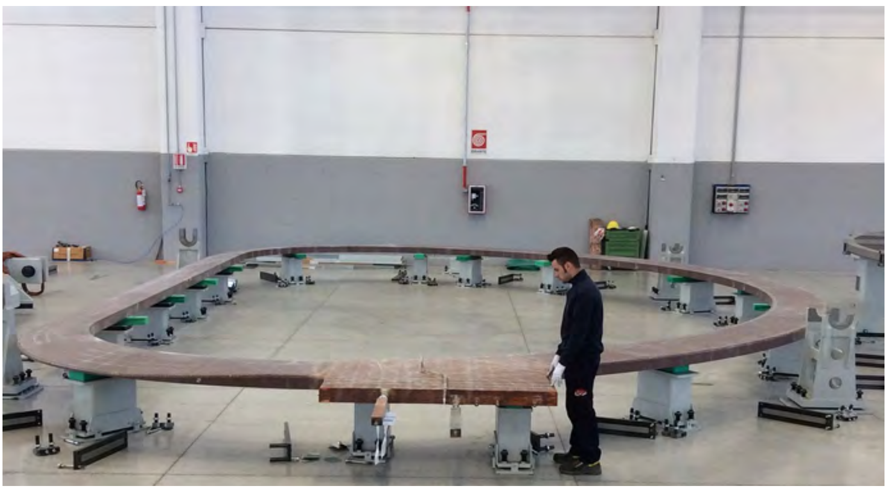
At the oven entrance, three series production DPs on their frame, being loaded to start the heat treatment. At the front, two previously treated DPs in ASG, La Spezia

Three turn insulation machines, operating simultaneously on three different series production DPs in ASG, La Spezia

Insertion of a DP inside the Radial Plate grooves in ASG, La Spezia. (Courtesy of ASG)

The laser welding machine in operation during welding of cover plates on a regular DP in ASG, La Spezia

Assembly of a series DP on the VPI mould, ready to be impregnated in ASG, La Spezia (Courtesy of ASG)



Result of the DP impregnation in ASG, La Spezia (Courtesy of ASG)

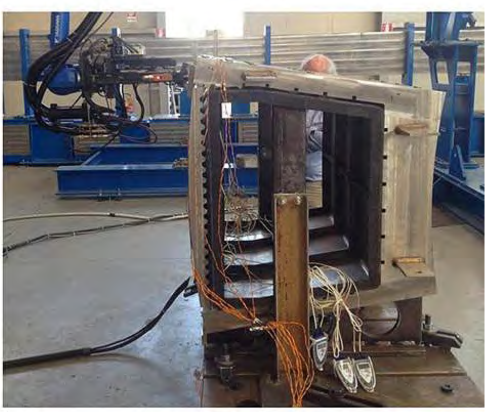
Series DPs, stacked together to form the first ITER TF coil Winding Pack in ASG, La Spezia (Courtesy of ASG)

Automated Winding Pack ground insulation operation in ASG, La Spezia (Courtesy of ASG)

- Follow-up for the cold test and the Winding Packs insertion into the coil cases (signature of the contract in May 2014 with SIMIC S.p.A.). The stage one is ongoing, special processes are being qualified and the main tooling are being designed and procured.

  o Qualification of the special processes ongoing:

  - Welding qualification and welding distortion analysis: welding qualification was successfully completed in August 2015. Welding distortion analysis is ongoing: the first one metre long and full-scale cross section mock-up has been completed in September 2015. Three more mock-ups addressing other parts of the TF coil geometry are to be welded during 2016;

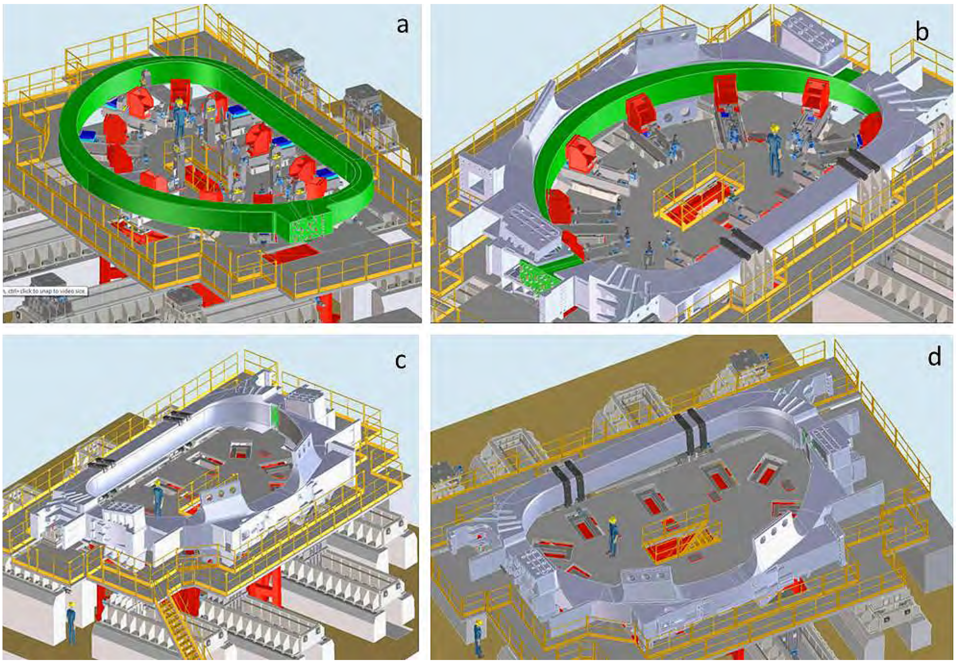


Welding distortion analysis: One metre long and full-scale TF coil case cross section mock-up completed in September

  - Welding inspection system: a system has been developed based on phased-array technique to inspect from one side a 120 mm thick weld. The system final qualification is foreseen for the beginning of 2016;
  - Gap filling resin qualification: qualified by means of a number of tests carried out during the year.

  o Main tooling;

  - Cryostat and cryo-facility: The facility in under manufacturing and will be ready for operation in 2016;
  - Gap filling facility: design completed and acceptance test of the tooling is foreseen for early 2016;
  - Insertion tooling: together with the supplier, we have defined a horizontal insertion process, different from the ITER IO baseline vertical insertion position. This reduces enormously the risks associated to the process as well as improves control of the relative position of winding pack and coil case and of the closure welding and gap filling processes; the final design of the tooling was in completed in September 2015. The tooling is under construction.

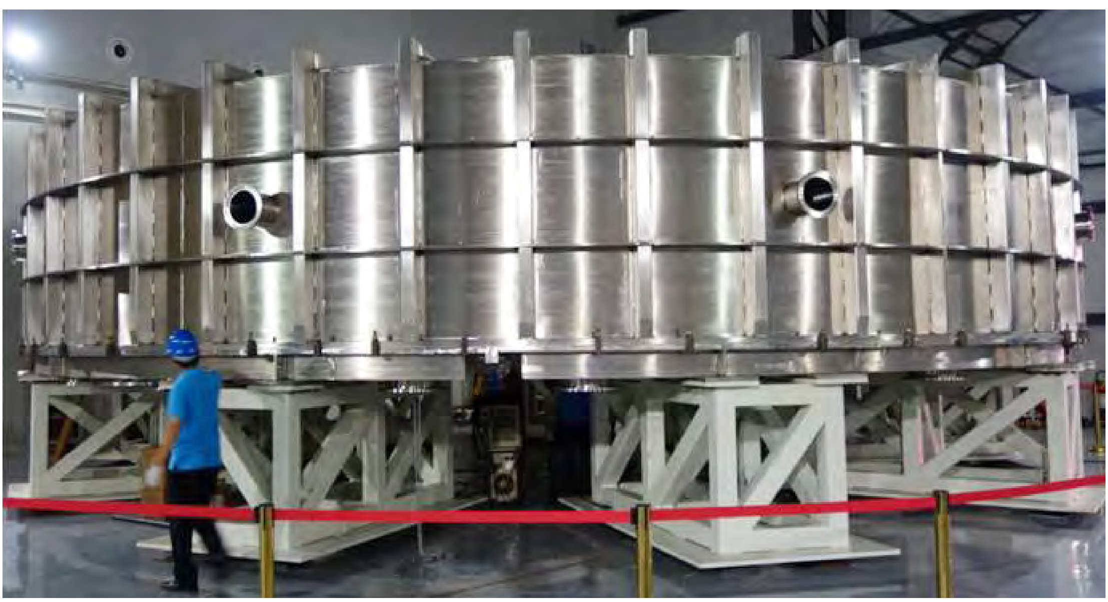


Insertion facility layout: a) WP positioning, b) TF coil case part is approaching the WP, c) closure weld, d) TF coil tilted and ready for gap filling

Progress Report on the Poloidal Field Coils

The collaboration agreement was signed with the Chinese institute ASIPP for the manufacturing of the sixth Poloidal Field coil (PF6) in late 2013. In 2015, the completion of the building acceptance took place in the summer and the winding tooling had extensive work carried out on it to validate and improve its performance leading to the start of acceptance tests at the end of the year. A range of specifications, control plans and schedules were also developed and accepted during the year for the qualification tooling, and qualification components as well as the lifting and impregnation tooling.

Some of the developments carried out at the ASIPP facility in Hefei, China and its suppliers: View of the Poloidal Field PF6 winding tooling machine in commissioning

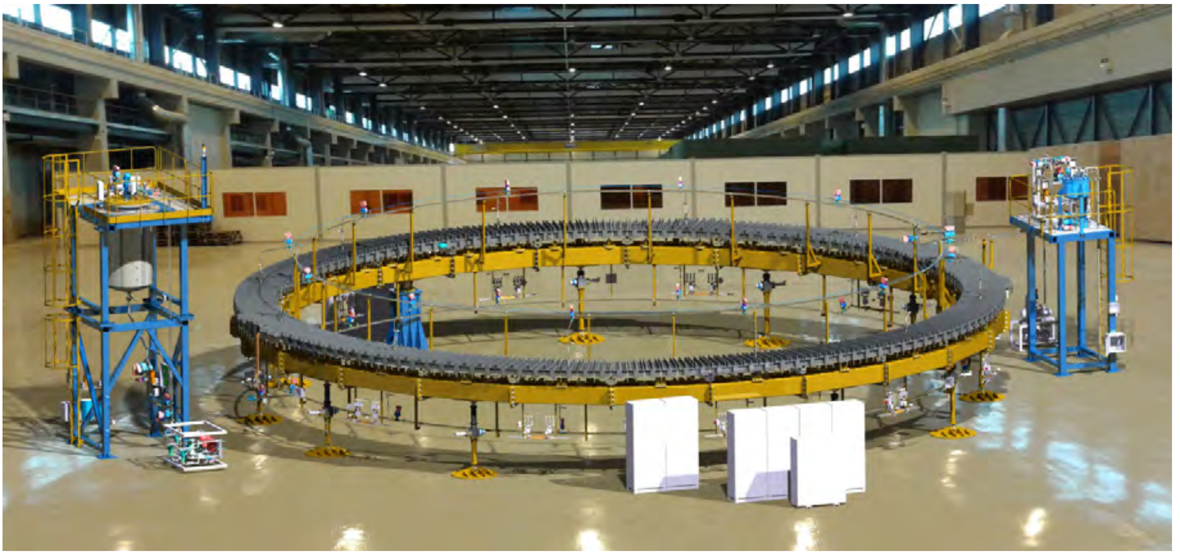


Some of the developments carried out at the ASIPP facility in Hefei, China and its suppliers: View of the PF6 DP Vacuum Chamber during commissioning at ASIPP

Regarding PF2-PF5 coils, the achievements are reported below:

- The engineering integrator contract, which started in August 2013, has moved forward significantly with the completion of the definition of all the technical specifications for the main contracts, completion of all of the drawings and a large number of the manufacturing procedures, as well as the acceptance of all of the component qualification tooling;
- The tender phase of the winding tooling contract was completed and the contract signed in May 2014 with SeaAlp – an Italian consortium. Since the contract was signed, the winding machine has been completed, delivered and part installed in the PF Building;
- Regarding the Site & Infrastructure contract which was signed in December 2014 with DALKIA-VEOLIA, during 2015 the majority of infrastructure work was completed in the building – installation of clean rooms, utilities, workshop rooms and the provision of all of the standard and special tooling. The remaining activities will be completed in April 2016;
- Regarding the additional tooling and impregnation tooling, the Call for tender was cancelled in early 2015 and relaunched as a negotiated tender leading to the signing of the contract in July 2015 with a consortium led by Elytt. The work has progressed well in 2015 with Preliminary Design Reviews (PDRs) completed for all of the tooling and even Final Design Reviews (FDRs) completed for the critical path tooling. The first tools will arrive on site in April 2016;
- Regarding the manufacture and cold test contract, the Call for tender was launched at the end of December 2014. Negotiations took place in the spring and summer of 2015 leading to the signing of the contract with CNIM in December 2015. The kick-off meeting was held before Christmas and the first stages of personnel recruitment, building and winding machine hand-over are due to be completed in the spring of 2016;
- Regarding the remaining contract to be signed the Cold Test facility contract, the Call for tender was launched in early 2015 and the competitive dialogue took place in the summer of 2015 leading to the final Call for tender in the autumn of 2015. The bids were received in late December 2015 and will be under evaluation in January 2016 with the expectation that a contract will be signed in March 2016.

PF 2-5 Winding Machine installation in the PF Building at the Cadarache site



PF 2-5 DP impregnation system – system overview

Progress Report on the Pre-Compression Rings

In 2014 the second 1/5 scale qualification ring was tested. The results were again well below the required performance. The causes were analysed and it was found that the main reason is that the 3 mm wide glass tape used for the winding, when bent on the plane of its flat surface on such a small bending radius tends to create wrinkles which strongly affect the quality of the ring. Therefore it has been established, also with the supplier and ITER IO, that the 1/5 scale ring is not a good qualification device.

A new qualification strategy has been defined and agreed with the supplier and ITER IO based on samples extracted from a full-size ring. In this way the properties of the samples are representative of the full-size ring. The manufacturing of a first full-size ring was completed in May 2015: unfortunately the results were not satisfactory. A set of potential causes were individuated and a number of corrective actions implemented by the supplier. A second full-size ring was built by the end of the year but, unfortunately, this was also unsuccessful. A new analysis of the possible causes was initiated together with the supplier, ITER IO and F4E defining potential options to solve the issues identified. Two new rings will be manufactured in the first half of 2016 utilising such options. In addition F4E, together with ITER IO, is intensively looking for back-up solutions with different technologies in order to make sure that successful pre-compression rings will be delivered on time to ITER site for the final assembly.

Vacuum Vessel

The vacuum vessel is the largest component of the ITER device and the total credit of the vacuum vessel is (92.19 kIUA). F4E is responsible for the in-kind procurement of seven sectors of the vacuum vessel.

Following F4E's signature in late 2010 of the contract with AMW, an Italian consortium of suppliers, the first stages for the fabrication of the first three sectors were released.

Executive Summary

Progress and major achievements for 2015 were:

- The finalisation of the analysis activity on simulations for welding distortions of the segments, required for the welding sequence optimisation and achievement of the tight tolerances;
- The completion of the detailed finite-element models of the sectors in order to have them ready for the fast treatment of non-conformities or deviation requests;
- The restarting of manufacturing on sector 5 in May, with the machining of the flexible housings of poloidal segment 1;
- The realisation of the first weld in AMW/Mangiarotti, on 29th June on the central T-rib of the poloidal segment 1;
- The realisation of the first weld in AMW/Walter Tosto on 3rd October;
- The completion of design and fabrication of the large majority of the main jigs for sector 5;
- Following the rejection of all stainless steel plates from the previous supplier, the placement of the order to HHI (Korea) for nine plates to be urgently shipped to Italy. In parallel, the order to Industeel for sector 5 plates, followed by the order for the plates for sector 4 and 3 were placed;
- The signature of the contract amendment with AMW in December 2015. This amendment introduced among other items, a new baseline schedule in accordance with the ITER IO request for the delivery dates of each of the sectors. At the same time, sector 2 and 9 were release to the consortium, bringing the total number of released sectors to five.

Progress Report

- Follow-up of the manufacturing contract for the vacuum vessel, involving manufacturing design, the fabrication of representative mock-ups, all required qualifications and the fabrication of seven sectors;
- Completion of all manufacturing drawings for sector 5, requiring continuous work to implement important information about metrology and intermediate tolerances. The preparation of manufacturing drawings for sector 4 has started;
- Procurement of all main materials for the fabrication of the first three vacuum vessel sectors (numbers 5, 4 and 3). Fabrication of the large majority of forgings for sector 5 has been completed.

Important progress in welding qualifications, both related to standard welding techniques (SMAV, TIG, etc) and Electron Beam Welding (EBW), reaching about 50% of the overall requested configurations.

Technical Challenges

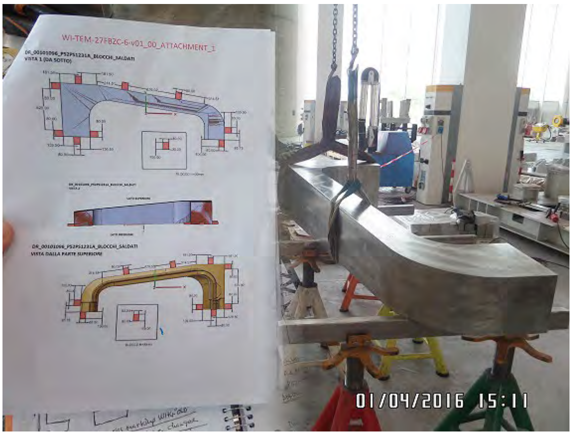
The main technical challenges encountered and the actions undertaken to resolve them were as follows:

- During the welding of the first weld of the vacuum vessel, on the central rib of the inboard segment poloidal segment 1, excessive distortion was found. This led to a non-conformity in production and necessitated reparation;

- The qualification of welding procedures, especially for Electron Beam Welding, necessitated an increased effort as technical difficulties were met. Remedial actions were implemented successfully;

- The ultrasound inspection of the large forgings was one of the most important technical challenges to be addressed; it created technical difficulties in covering all the inspection volume, due to the attenuation of the forging material. A Working Task Force was created to progress with this issue.

Automatic TIG welding qualification



Large forging of the vacuum vessel

First weld of vacuum vessel sector 5 - Central rib of the poloidal segment 1

Machining activity on large forging

In-Vessel Components

F4E is responsible for the in-kind procurement of the following:

- Blanket First Wall: 48.4% of the first wall panels corresponding to the Normal Heat Flux First Wall (40.33 kIUA);
- Blanket cooling manifold (4.522 kIUA);
- Divertor Inner Vertical Target (19.62 kIUA);
- Divertor cassette bodies and integration of plasma-facing components (10.88 kIUA);
- Divertor rails (2.38 kIUA).

Executive Summary

In the area of the in-vessel components, the main achievements during 2015 are as follows:

- Finalisation of the last 3D CAD models of the Normal Heat Flux (NHF) First Wall (FW) panels in the F4E scope of supply for the ITER blanket;
- Successful pre-qualification of F4E for the supply of the ITER First Wall, in the frame of the ITER Blanket First Wall qualification programme. The final meeting was held on 1st December 2015;
- Successful completion of the pre-manufacturing review for the three contracts for the manufacturing of First Wall Full Scale Prototypes with respectively Atmostat, Areva and the Consortium Iberdrola/Amec FW/Leading;
- Closure of Task 1 of contract OPE-284 with Areva (including the manufacturing of three upgraded NHF small-scale mock-ups, one standard NHF semi-prototype and one upgraded NHF semi-prototype);
- Completion of the Blanket First Wall semi-prototype manufactured in the frame of procurement contract by the Consortium Iberdrola/Amec FW/Leading;
- Completion of the Enhanced Heat Flux (EHF) Blanket First Wall semi-prototype manufactured in the frame of procurement contract OPE-097-02 with Atmostat;
- Successful High Heat Flux (HHF) testing at Efremov Institute, in the frame of procurement contract OPE-400, of the second half of the Blanket FW qualification semi-prototype manufactured in the frame of the contract;
- Successful HHF testing at Forschungszentrum Jülich, of the first half of the Blanket FW semi-prototype;
- Completion of the first HHF test campaign at Jülich of an irradiated mock-up;
- Signature of the contract for the HHF testing of three FW semi-prototypes (manufactured by Areva, Atmostat and the consortium Iberdrola/Amec FW/Leading);
- Signature of the stage 1 of three framework contracts for the pre-qualification of additional suppliers for the procurement of the all-tungsten divertor Inner Vertical Target (IVT);
- Completion of the procurement of alternative tungsten grade and CuCrZr alloy material for the divertor IVT;
- Fabrication and qualification of the four additional all-tungsten full-size plasma facing units.

Progress Report on In-Vessel Components

During 2015, progress in the development of In-vessel components was achieved for the following systems: the blanket First Wall, the blanket cooling manifolds, the divertor Inner Vertical Target and the divertor cassette body.

Progress Report on the Blanket First Wall

Main achievements in the area of the blanket First Wall (FW):

- The Normal Heat Flux (NHF) FW design and analysis to support ITER IO was performed in the frame of the Blanket Integrated Product Team (BIPT) Task Agreement as follows:

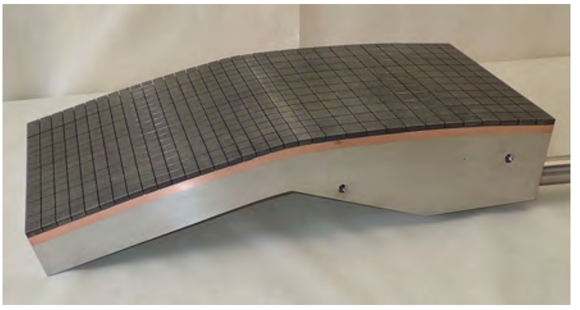
  - o Finalisation by F4E of the detailed three-dimensional computer-aided design (CAD) models and associated two-dimensional drawings of the FW panels in the F4E scope of supply for ITER. The CAD models of the last 18 minor variants were completed in July 2015 and will be included in the documentation package of the Procurement Arrangement to be signed with the ITER IO Central Team.

- Concerning the ITER FW qualification programme to prepare for the procurement of the blanket FW panels, the main developments have been:

  - o The ITER Task Agreement aimed at the pre-qualification of F4E for the supply of the NHF FW panels for ITER, was closed successfully. The second campaign of High Heat Flux (HHF) testing of the semi-prototype has been completed in the time frame May-July 2015. Conclusions were discussed with ITER IO during the closure meeting held in Cadarache on 1st December 2015;
  - o Successful completion of the pre-manufacturing reviews of the three procurement contracts for the fabrication of FW qualification full-scale prototypes (with Alcen/Atmostat, Areva and the Consortium Iberdrola/Amec FW/Leading, respectively) and consequent authorisation to start the manufacturing of the stainless steel and CuCrZr parts of the FW full-scale prototypes.

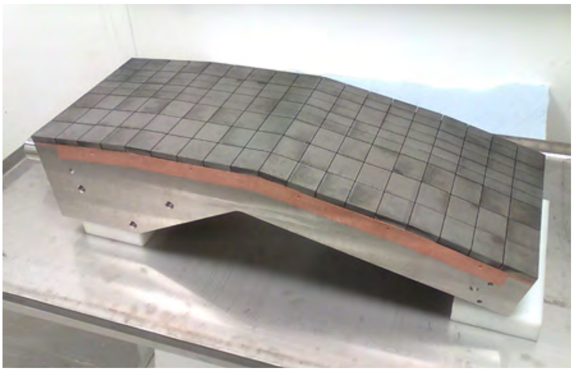
- As part of the manufacturing activities, follow-up of the three procurement contracts for the fabrication of NHF First Wall mock-ups and semi-prototypes (with Alcen/Atmostat, Areva and the Consortium Iberdrola/AMEC FW/LEADING respectively).

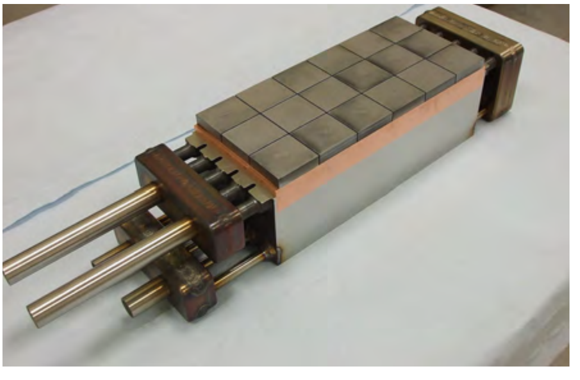
  - o Task 1 (manufacturing of three upgraded NHF small-scale mock-ups, one standard NHF semi-prototype and one upgraded NHF semi-prototype) of contract OPE-284 has been completed in October 2015;
  - o The manufacturing of the Enhanced Heat Flux (EHF) semi-prototype by Atmostat has been completed in October 2015;



EHF First Wall semi-prototype manufactured by Atmostat-Alcen

  - o One semi-prototype and one R&D mock-up were completed in March and December 2015 respectively.

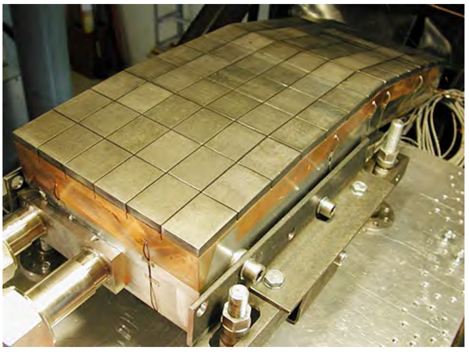




First Wall semi-prototype (left) and general R&D mock-up manufactured by the Consortium Iberdrola/Amec FW/Leading

- As part of the High Heat Flux testing activities, it is worth mentioning the following achievements:

- o The second half of the first semi-prototype completed earlier under OPE-284 was successfully HHF tested in the electron-beam test facility Tsefey-M at the Efremov Institute (Russia);

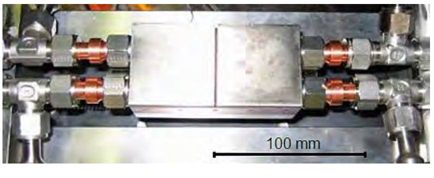


First Wall qualification semi-prototype manufactured by AREVA and tested at TSEFEY-M

- o The first half of the semi-prototype completed under OPE-394 was successfully HHF tested in the electron-beam test facility JUDITH-2 at the Forschungszentrum Jülich (Germany);

First Wall semi-prototype manufactured by the Consortium IBERDROLA/Amec FW/Leading and tested at JUDITH-2

- o One mock-up manufactured by CEA and exposed to neutron irradiation up to 0.75 dpa in beryllium in the RBT-6 fission reactor at Dimitrovgrad (Russia) was HHF tested in the electron-beam test facility JUDITH-1 at the Forschungszentrum Jülich;



Installation of the irradiated Be mock-ups in JUDITH-1

- o A first design review meeting for the manufacturing of the Test Facility HELCZA, mainly devoted to the heat flux testing of FW panels during series production, was held on 27th January with the attendance of representatives from ITER IO, F4E, AREVA (technical support to F4E), CV Rěz (supplier) and ENVINET (subcontractor). The detailed design of the main subsystems of the Electron-Beam Test facility was then provided by CV Rěz. The first components (vacuum chamber, electron beam gun, vacuum pumps) have been delivered on-site. The detailed design and fabrication of the remaining systems, as well as the on-site integration, are in progress.

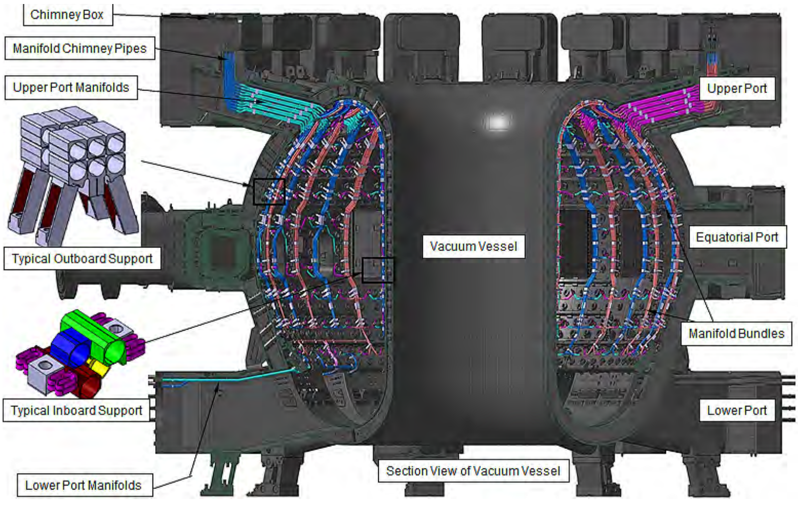
- R&D in support of the FW procurement:

  - o In 2015 the R&D on materials focused on qualification and industrialisation of CuCrZr alloy and its Hot Isostatic Pressed (HIP) joints. Two irradiation campaigns were completed (with TÜV & SCK•CEN and with NRG & MTA). CuCrZr (bulk material and joints) was irradiated to simulate ITER operating conditions up to 0.01, 0.1, 0.7 and 1.6 dpa and the mechanical properties (creep, tensile, fatigue and impact) were characterised. Materials performance was demonstrated to be acceptable for ITER operation. Procurement contracts (with LBA and with Metalminotti) provided CuCrZr material for the full- scale prototypes and were also a test bench for the ITER-specific material requirements in view of future series production. In addition, material characterisation samples from FSP manufacturing were assessed by Tecnalia;
  - o A grant was conceived to identify possible repair techniques for replacing beryllium tiles on the NHF FW panels. The possible repair techniques were ranked according to design requirements and manufacturing feasibility and, for the two down-selected techniques, a detailed development/ qualification plan was proposed by CCFE;
  - o A grant was conceived to develop a manufacturing sequence for the FW beam based on additive manufacturing. The Consortium led by the Chalmers University of Technology will build using additive manufacturing parts which will be joined by HIPing to form a FW supporting beam;
  - o Dedicated analyses were performed to assess the feasibility of design solutions aiming at an overall optimisation of the current FW design from the manufacturing and cost standpoints, also as a result of the feedback obtained from the manufacturers of the FW mock-ups and prototypes.

Progress Report on the Blanket Cooling Manifold

The design of the blanket cooling manifolds is basically completed and has been validated by means of analyses and prototypes. The only exception is the pipe support design for which two different options (brazed and mechanical attachment) are still being considered. Feedback from additional analyses and mock-ups are needed before the best option is retained for series production.

The Final Design Review of the blanket cooling manifolds successfully took place in December 2015. The purpose was to identify, solve and finalise outstanding design issues before procurement begins. With the exception of the difficulties reported for the development work performed on the alumina coating by brazing of the pipe support, the conclusions of the panel were positive.



View of the blanket cooling manifold inside the vacuum vessel

Progress Report on the Divertor Components

Main achievements in the area of the divertor Inner Vertical Target (IVT):

- The competitive dialogue launched in 2014 for the pre-qualification of additional suppliers for the procurement of the divertor IVT was successfully completed with the award of 3 framework contracts with respectively Atmostat-Alcen, CNIM-TPI and Research Instruments GmbH. The scope of the contracts is split into two stages. The first stage concerns fabrication technology demonstration and validation with the manufacturing and testing of small-scale components. Successful candidates will participate to a re-opening of competition for the award of up to two contracts for the manufacture of full-scale prototypes in the frame of stage 2. Kick-off meetings were held and the three companies started with the development programme and the manufacture of the first mock-ups. The technologies developed include Hot Isostatic Pressing (Atmostat), induction brazing (CNIM) and vacuum brazing (RI).
- The procurement of tungsten monoblocks and CuCrZr pipes from AT&M company has been completed. Four hundred monoblocks and eight metres of CuCrZr pipes have been delivered. The materials are made available to the companies involved in the above contracts to speed up the development stage.
- The on-going activities with Ansaldo Nucleare (ANN) aiming at manufacturing a full-size IVT prototype have continued. The manufacturing of the tungsten monoblocks including W plate machining and pure copper casting has been completed at Ansaldo Energia. The initial documentation has been approved. Welding qualification is almost completed. For first time in the EU, four all-tungsten full-size IVT Plasma Facing Units (PFUs) have been fabricated at ANN subcontractor ENEA Frascati. The PFUs have undergone non-destructive examination by ultrasonic testing and dimensional checking has been performed by laser tracking. The fabrication of the PFU test frame has progressed at ANN subcontractor Walter Tosto.

The full-size plasma facing units fabricated by ENEA subcontractor of Ansaldo Nucleare

The test frame fabricated by Walter Tosto, subcontractor of Ansaldo Nucleare

In the area of the divertor Cassette Body (CB) the three multiple framework contracts for the procurement of the divertor cassette bodies (OMF-444 Lots 1, 2 and 3) are ongoing. The baseline of these contracts consists of the manufacturing of one full-scale cassette body prototype per company and, for the successful companies, to participate to a re-opening of competition for the series production. During 2015 good progress was made by the three involved companies, namely the CNIM-SIMIC Consortium, Holming Works and Walter Tosto for Lots 1, 2 and 3 respectively. The initial report related to the complete engineering documentation for the cassette body and its transportation jig, the welding qualifications and the welding data package were finalised for Lots 1 and 3. The engineering documentation for the CB was almost completed for Lot 2. All stainless steel materials required for the manufacturing of the CB structure were delivered for the three Lots. Manufacturing activities for Lot 1 and Lot 3, and welding qualifications for the Lot 2 have started.

Cassette body prototype under fabrication at CNIM

Remote Handling

F4E is responsible for the in-kind procurement of the following:

- Divertor Remote Handling System (DRHS) (9.62 kIUA);
- Cask and Plug Remote Handling System (CPRHS) (17.31337 kIUA);
- In-Vessel Viewing System (IVVS) (6.8 kIUA – moved by ITER IO in 2014 from RH to DIA PBS);
- Neutral Beam Remote Handling System (NBRHS) (6.0 kIUA).

Executive Summary

In the area of Remote Handling (RH), the main highlights of the achievements during 2015 are as follows:

- Signature of the task order with Assystem UK (AUK), for the execution of the design of the DRHS until completion of the preliminary design review;
- Signature of the NBRHS procurement contract with Amec Foster Wheeler as first contractor in the cascade; start of the procurement activities with the signature of the first task order related to preparatory activities to the preliminary design phase;
- Completion of the grant with CCFE for the NBRHS cutting/welding technologies;
- Execution of the dialogue and tendering phase for the CPRHS procurement, and completion of the technical part of the tender evaluation;
- Completion of the tendering phase for the IVVS procurement, award and signature to CNIM-Bertin as first contractor in the cascade. Start of the first task order related to preparatory activities to the preliminary design phase;
- Signature of the Procurement Arrangement (PA) for the CPRHS with the ITER IO Central Team;
- Placement of task orders with the F4E RH engineering support contractor:
    - o Support to evaluation of tenders for IVVS and CPRHS;
    - o The development of rad-hard camera demonstrator for RH applications;
    - o The development of rad-hard electronics (fieldbus acquisition module);
    - o IVVS development and prototyping.
- Placement of task orders from other framework contracts in the following areas:
    - o Updated nuclear analysis on IVVS
    - o Irradiation-test based assessment of rad-hard camera demonstrator for RH applications
    - o GENROBOT Development and Validation

The above activities are also mentioned in the following sections covering the various RH packages/areas.

- Execution of the tendering process for a new engineering support contract (to replace the expired engineering support contract which expired on 5th December 2015), resulting in the award and signature with Oxford Technologies Limited as the first contractor in the cascade.

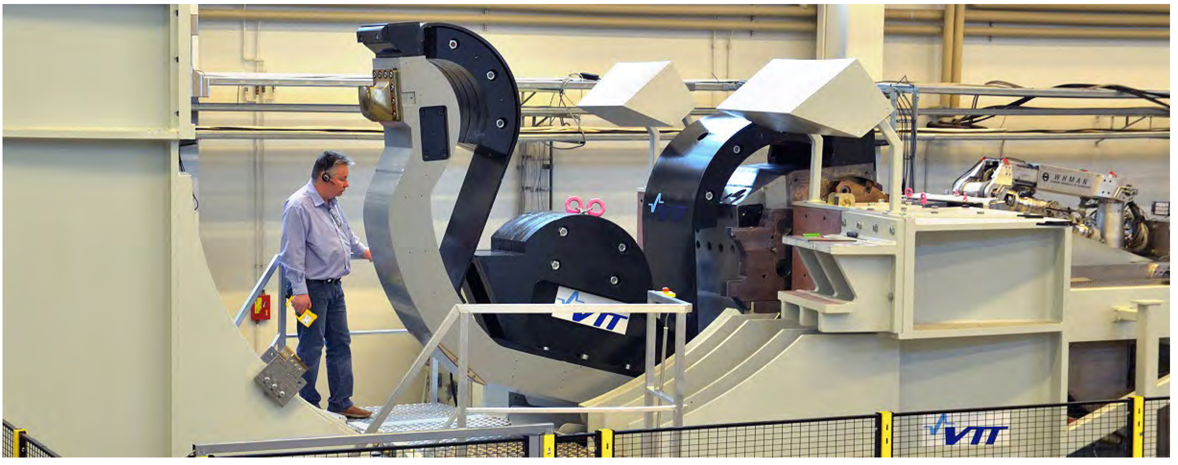
Progress Report on Divertor Remote Handling

During 2015 the execution of the first task order, launched during 2014 with AUK, has led to the definition and implementation of a second, short-term task order to complete the preparation of the design activities. A third task order was signed in December 2015 that includes design effort that should lead to a preliminary design review of the Divertor Remote Handling system design in mid-2017.

At the same time, design validation support activities have continued at the full-scale divertor test platform (DTP2) facility (located in Tampere, Finland), in the frame of a grant that has been completed in February 2015 with the final tests on the so-called central divertor cassette installation.

This successful action has also provided useful indication on improvements linked to the design of the cassette locking system, and generated a new grant starting in mid-2015. Further testing will be carried out again at DTP2 and should experimentally demonstrate the validity of the modifications in early 2016.

Moreover, the availability of a test bed as unique as DTP2 has been fruitful in launching a second action in the control system area for DRHS and other packages.



Central cassette installation test in DTP2 in February 2015

Progress on the Cask and Plug Remote Handling System (previously known as the Transfer Cask System)

The main achievements for the CPRHS have been the signature of the Procurement Arrangement in June 2015, following a detailed analysis of system requirements and interfaces, and the execution of the dialogue and tendering phase for a framework contract related to the design and manufacturing of the cask fleet.

The bulk of the procurement process has started after the presentation, in early 2015, of the so-called business case to the tenderers (which they had to undertake to demonstrate their competence against a representative set of tasks related to the design and manufacture of this safety important system). After submission of the bids, the tender evaluation period started in September 2015 and, with the aid of the engineering support contractor, the technical part of the tender evaluation was completed in December. In January 2016 we expect to finalise the tender evaluation report and submit the award decision in order to have the contract signed during Q1 2016.

In support of the CPRHS development a task order with Oxford Technologies Limited, initially launched in 2014, was successfully concluded during 2015 addressing some specific CPRHS technical issues:

- The analysis of the system technical requirements, to optimise the input data for the CPRHS procurement contract;
- The sequence of cask operations required for the maintenance of the RH class 1 components;
- The low level control system (requirements in terms of cabling and cubicles with the associated cost);
- An impact assessment of the procurement of an extra-large cask for the Neutral Beam components;
- A technical assessment of the seal design when two casks are docked together as is the case of two Blanket RH System casks.

Progress on the In-Vessel Viewing and Metrology System

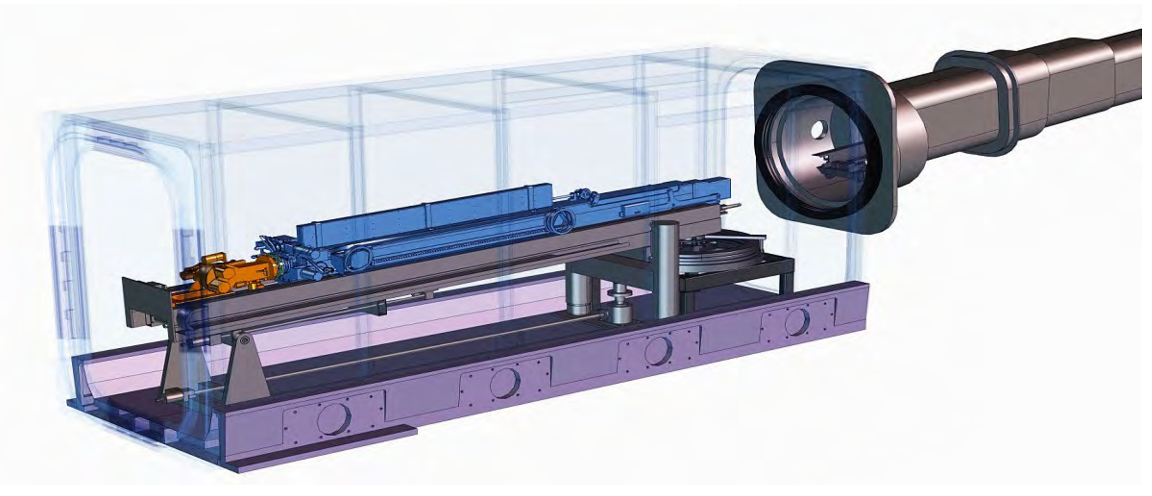
Following the signature of the Procurement Arrangement in December 2014, the main focus has been the execution and completion of the IVVS tender procedure. In November 2015, the IVVS procurement contract was signed with CNIM-Bertin as first in cascade and the first task order was signed by the end of 2015. The task order covers the analysis of the system requirements, the conceptual design, the definition of the preliminary design activities, and includes a series of thematic workshops with the supplier to enable a dynamic collaboration with F4E. This task order will be performed during 2016.

During 2015, in parallel with the selection of the IVVS supplier, other activities have been carried out:

- A new task order with Oxfords Technologies Limited has been executed to perform further optical studies, including assessment of a scanning system in presence of temperature variations and usage of long optical fibres between the source and scanning unit, and the development a concept design of the IVVS plug installation tool embedded in the IVVS cask (one of the CPRHS cask variants);

- An updated neutronic analysis of the IVVS (in liaison with F4E Technical Support Services) to better reflect the IVVS current concept and to obtain radiation data in the port cell.

Both activities are due to finish during the first half of 2016.



The IVVS in the cask and the related in-cask equipment for inserting it into the vacuum vessel port extension (on the right)

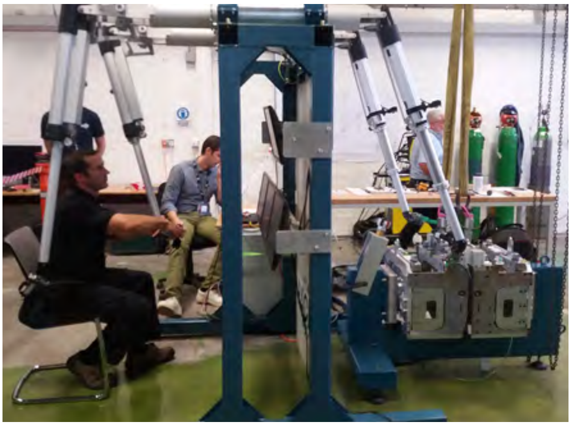
Progress on Neutral Beam Remote Handling

One major activity has been the completion of the tendering process for the NBRHS procurement contract, followed by the awarding and signature of the contract with Amec Foster Wheeler as first in the cascade in March 2015. Following an intense period of preparation, the first task order was started in July 2015 and related to:

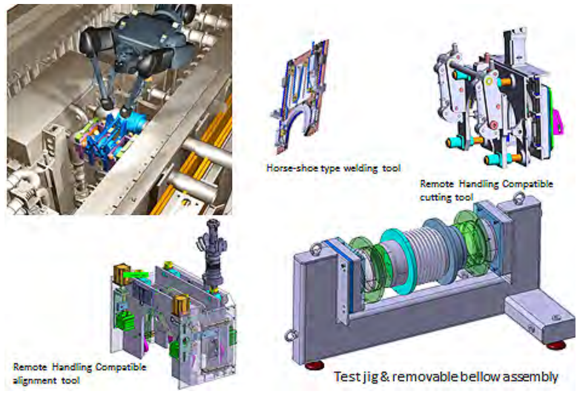
- Analysis of NBRHS system requirements and interfaces;
- Review of the concept design;
- Set-up of collaboration tools for requirements and CAD data management;
- Definition of a development plan for the preliminary design.

This task order is still under execution. During the work, F4E and the supplier have undertaken an interactive approach, for example with thematic workshops, in order to establish a deep level of collaboration.

In parallel, the activities related to a grant for “Remote pipe & lip seal maintenance R&D” have been performed and have culminated with the successful execution of cutting/welding tests at CCFE RACE laboratories.



RH cutting/welding tests in the full-scale mock-up for NB pipelines and bellows



Snapshots illustrating the NBRHS pipe tooling design

Progress on Remote Handling cross cutting technologies Control System

The remote handling control system (RHCS) is designed by integrating a set of advanced and heterogeneous functional modules for full and safe remote operations. In 2015, following the lines of development already identified during the previous year, progresses have been made in the following areas:

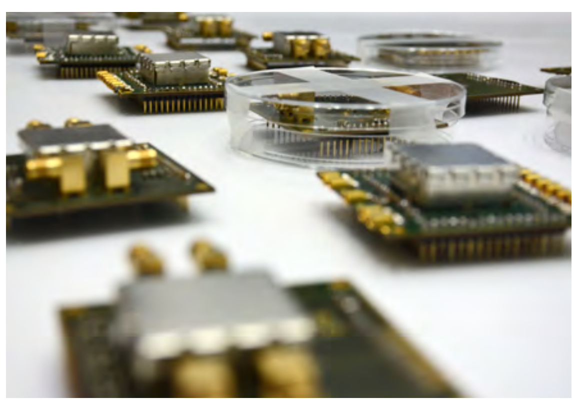
- Successful completion of the activities related to:
    - o Design and validation of technical solution for long cable distance for a slave manipulator arm
    - o Assessment of 3-D stereo vision for teleoperation
    - o Development of a database of failure modes and effects for various kinds of electrical actuators;
- Completion of the development plan, and subsequent start in 2015 of the first development step for GENROBOT (implement infrastructural components and identify formal approach to SIL-2 software qualification) to continue in 2016;
- Definition and start of a grant with VTT and TUT on DTP2-based development of remote diagnostics for RH systems, and computer aided teleoperation using stereo cameras and synthetic viewing. This action will continue during 2016.

The ITER Compatibility Assessment of Remote Handling Equipment (ICARHE) program

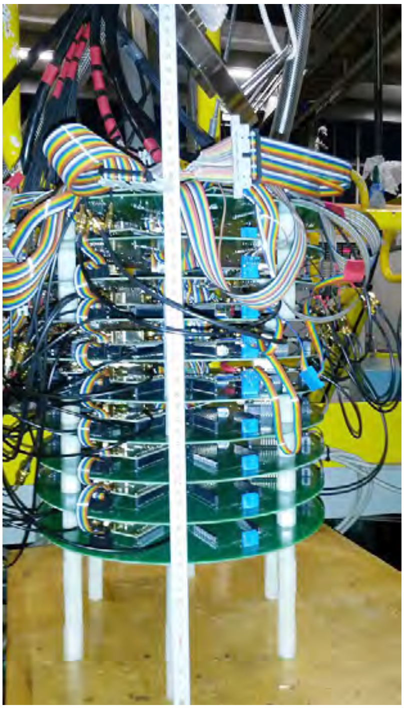
Within the radiation hardness assurance working group coordinated by ITER IO where a F4E RH member is participating, a policy was developed for the procurement and due qualification of electronics exposed to radiation in the ITER facilities.

In line with this policy, a radiation tolerant front-end chip for read-out and multiplexing of embarked sensors for RH equipment was designed in 2014 and has been successfully tested by Oxford Technologies Limited in 2015 under gamma radiation up to a cumulated dose of 1 MGy.

The follow-up of this activity have been on the one hand the development of a communication interface (fieldbus) through a specific task order, and on the other hand the



Prototype rad-hard chips production



Prototype rad-hard chips in the test bed before irradiation

signature of a cooperation agreement with KU Leuven for the commercial exploitation of this chip technology (in agreement with dual use regulations for technology transfer).

Furthermore, the task order for design and production of a miniaturized radiation tolerant CMOS-based camera sensor has been launched in 2015 and, once the prototypes are ready, gamma irradiation tests up to 1 MGy are planned. For these tests, a separate task order has been started already at the end of 2015 in order to prepare the test procedures, the measurement system and to launch the real campaign during 2016.

Cryoplant and Fuel Cycle Systems

F4E is responsible for the in-kind procurement of the following:

- Liquid Nitrogen Plant and Auxiliary Systems, approximately one-half of the cryoplant (26.39878 kIUA);
- Warm regeneration lines, front-end cryodistribution with cold valve boxes, torus and cryostat cryopumps, cryopumps for the Neutral Beam system and leak detection and localisation system (12.966 kIUA);
- Tritium plant consisting of the Water Detritiation System and the Isotope Separation System (6.33908 kIUA);
- Waste Management System (10.1 kIUA);
- Radiological and Environmental Monitoring Systems (4.2 kIUA).

Executive Summary

In the area of Cryoplant and Fuel Cycle, the main highlights for 2015 are the following:

Cryoplant

- The manufacturing of long lead items started as early as February 2015 with the manufacturing readiness review of heat exchangers. By the end of the year some equipment had already been factory acceptance tested (brazed aluminium heat exchangers, valves);
- The final design of the LN2 Plant and Auxiliary Systems was performed on schedule and was assessed by an independent review panel which met in F4E premises on 15th, 16th and 17th July 2015;
- The steering committee of the Final Design Review concluded that the proposed design met the requirements and was sufficiently mature to authorise starting the next phase of the project, i.e. the integration of the components in the compressor stations and cold boxes;
- The competitive dialogue for the MITICA cryoplant was initiated and the Call for final tender issued in December.

Cryopumps and Cryodistribution Lines (Vacuum Pumping, Leak Detection and Localisation)

- The tests to assess the functional and mechanical performance of the components of the warm regeneration lines were carried out;
- The manufacture of the pre-production cryopump continued. Components were manufactured, the cryopanels charcoal coated and the assembly sequences were prepared;
- The technical specifications for the MITICA cryopump were reviewed and agreed upon with ITER IO with a view to signing the Procurement Arrangement in early 2016

Tritium Plant

- The Water Detritiation System (WDS) large tanks (100 m^3 and 20 m^3 volumes) were delivered to ITER IO. These tanks were the first ITER equipment delivered by F4E on the ITER site in Cadarache;
- The preliminary design for WDS (excluding tanks) progressed in 2015 through a contract placed with Kraftanlagen;
- The Procurement Arrangement amendment for the supply of WDS smaller tanks (6.7 m^3 and 12 m^3 volumes) was signed in December 2015.

Waste Management System (WMS)

- The task order for the cost assessment at completion of the Type-A Radwaste package was completed.

Radiological and Environmental Monitoring Systems (REMS)

- The task order for the preliminary design of Tokamak REMS was completed.

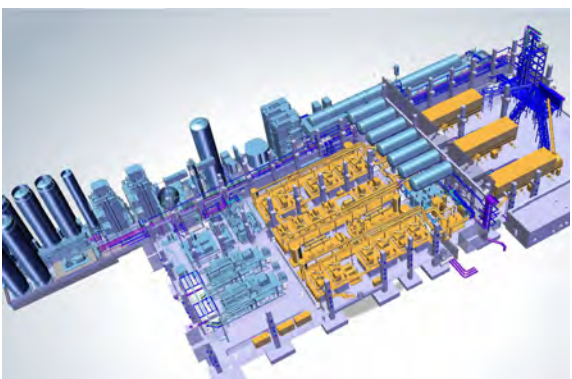
Progress Report on the Cryoplant

The final design phase of the LN2 Plant and Auxiliary Systems, which started in September 2014, was achieved in 2015: process flow diagrams, piping and instrumentation diagrams, calculation notes, electrical drawings, manufacturing drawings, 3D models, civil guide drawings, interface documentation, process data sheets, Hazard and Operability studies, Reliability, Availability, Maintainability and Inspectability studies were finalised.

The purchase orders for the remaining long lead items, i.e. the components of which are on the critical path regarding the delivery schedule, were launched: turbines, gaseous helium tanks, cryogenic valves, warm valves, nitrogen vessel and separator, thermo-siphon capacity, instrumentation, analyzers, and gas bags.

The data required for the design of interfacing systems such as the building and the other equipment of the cryoplant was provided according to the ITER integrated schedule.

GTD Sistemas submitted a prototype interfacing the Liquid Nitrogen Plant and Auxiliary Systems process control with the ITER machine overall supervision system.



The general layout of the various components of the cryo-plant

A major milestone was achieved with the Final Design Review of the Liquid Nitrogen Plant and Auxiliary Systems in F4E premises on 15th, 16th and 17th July 2015. The design review panel included European experts in cryogenics and delivered an independent assessment of the final design. No chit 1 was issued. Chits 2 mainly referred to interfaces, tests and design completion of some ancillaries. They concluded that the proposed design met the specifications and had reached an appropriate level of maturity. The review panel report was fully endorsed by the ITER IO-F4E joint steering committee which authorised proceeding to the next phase, the manufacturing integration of the components of the Liquid Nitrogen Plant and Auxiliary Systems. The Manufacturing Readiness Reviews were held gradually and the manufacturing authorisations for all equipment released: brazed aluminium heat exchangers (February 2015), diffusion bonded heat exchangers and LHe tank (March 2015), LIN tank (April 2015), GHe tank, LN2 Plant separators, quench tanks, compressors, turbines (May 2015). After factory acceptance testing some components were accepted in 2015: heat exchangers, motors, valves. Other big components such as the LHe tank have already reached the stage of intermediary testing. Finally, the manufacturing readiness review of the LN2 Plant and 80 K Loop cold boxes in December 2015 authorised the integration of those assemblies.

Aluminium-brazed heat exchanger acceptance

LHe tank inner vessel helium leak test

Significant effort was dedicated to the preparation of the on-site installation and test activities which entails a thorough coordination with the other providers of cryogenics equipment, ITER IO and the Indian Domestic Agency (IN-DA), F4E Site and Building and Power Supplies Project Team, and Air Liquide.

Logistics is another area which required extensive planning. Though transport of all the equipment to the ITER site in Cadarache is included in the contract placed with Air Liquide, packing and shipping of the heavy exceptional loads must be prepared and optimised with ITER global logistics service provider, Daher. Besides, storage areas have to be defined and selected as well to accommodate buffers as to store the equipment between the release of their factory acceptance testing and cryoplant building availability for installation.

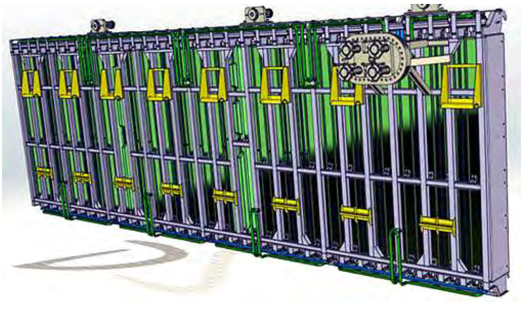
After the Call for expression of interest at the end of 2014, the competitive dialogue for the supply of the MITICA cryoplant was initiated in March 2015, the technical specifications and the contractual provisions were negotiated and the Call for final offer was released in December 2015.

Progress Report on the Cryopumps and Cryodistribution Lines

The procurement of the warm regeneration lines is on-going and the final design has been progressed by Criotec which have performed analyses and tests to check the functional and mechanical components (insulation material, line section, gasket etc.) which have been selected. The Final Design Review is in preparation for 2016.

The manufacture of the pre-production cryopump, under a task agreement, is a major pre-procurement arrangement activity for the build-to-print definition of the torus and cryostat cryopumps, as well as a spare pump. Components and sub-systems have been manufactured and inspected so that the assembly of the pump will start early 2016.

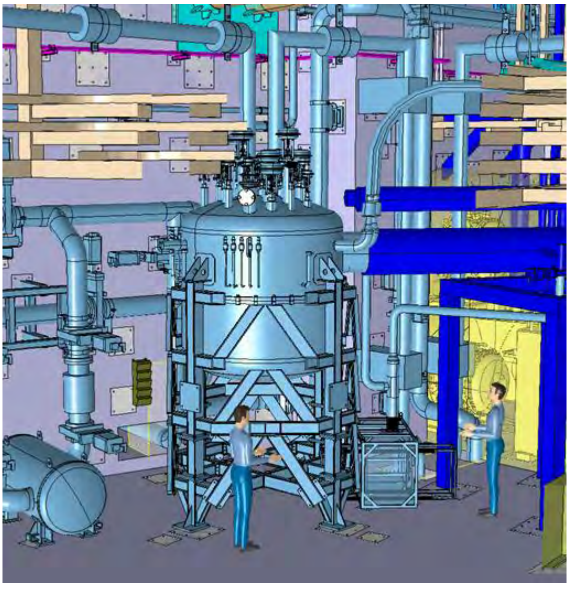
The pump plug of the pre-production cryopump in manufacturing



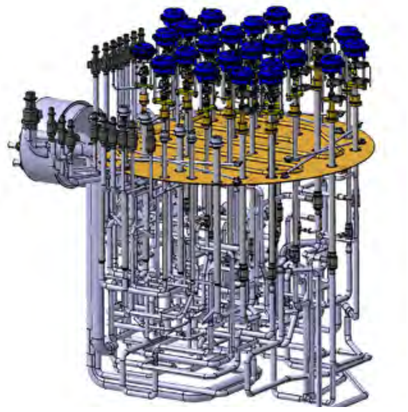
3D model of the MITICA cryopump

Major effort has been spent on the completion of the pre-procurement activities of the MITICA cryopump. This pump is identical to the ITER Neutral Beam pumps and serves as a prototype. It will be installed in the MITICA facility in Padua, Italy. All aspects of the build-to-print design, namely the technical specifications, drawings and interfaces have been addressed so that the Procurement Arrangement (PA) could be signed early 2016.

Progress has also been made in the definition of the Procurement Arrangement of the Front-End-Cryopump Distribution System of ITER which includes the Cold Valve Boxes, the Warm Regeneration Box, several cryolines as well as its control and instrumentation system. These components play a key role in the safe and timely operation as well as regeneration of the ITER torus, cryostat and Neutral Beam cryopumps. The aim is to sign the PA according to plan in 2016.



View of the Neutral Beam Cold Valve Box integrated in the ITER environment



View of the complex piping network of the Torus Cold Valve Box (courtesy of IDOM)

Progress on the Tritium Plant

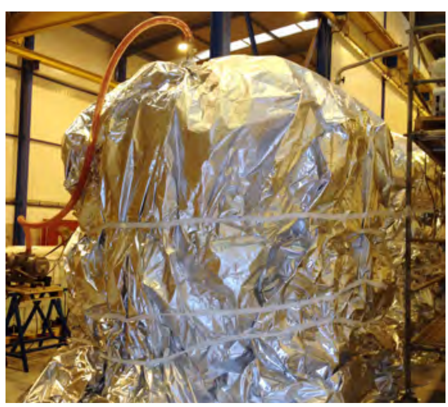
Water Detritiation System (WDS)

In the frame of the contract F4E-OPE-500, Equipos Nucleares S.A. designed and manufactured two 100 m^3 tanks and four 20 m^3 tanks for the Water Detritiation system, which passed successfully the factory acceptance tests (FAT) which included helium leak and hydrostatic pressure tests. These tanks were transported and delivered to ITER site between February and May 2015 using DAHER logistics services.

100 m^3 tank at manufacturer before Factory Acceptance Tests

20 m^3 tank before Factory Acceptance Tests

Helium leak test of 100 m^3 tank



Helium leak test of 20 m^3 tank

Delivery at ITER site of a 100 m³ tank

Head for 20 m³ tank with holes for nozzles

In the frame of the contract placed with Kraftanlagen GmbH, the WDS preliminary design was submitted to the ITER IO HAZOP assessment.

Following the ITER IO request the WDS Tank procurement PA scope was changed including the early delivery (2018) of four more WDS tanks: two High Tritium Level Holding Tanks (6.7 m³) and two feeding tanks (12 m³). The preliminary design of such tanks was completed in the frame of the F4E-OPE-421 and passed the Preliminary Design Review organised by ITER IO in October 2015.

Isotope Separation System (ISS)

A common strategy has been agreed with ITER IO for the activities till PA signature. In 2015, ITER IO has been developing the conceptual Design of ISS that should be available for Conceptual Design Review in 2017.

Progress Report on the Waste Management System

For the Waste Management System, 2015 activities were mainly devoted to the finalisation of an estimate at completion for the costs of the Type-A radwaste system. Specific assessments and analyses were also conducted in support of an effort to re-group all radiological and non-radiological waste activities under ITER IO control, which included preliminary negotiations on transfer of scope under the WMS Procurement Package.

F4E also participated in specific meetings with ITER IO, the European Commission and Agence ITER France on the overall ITER Waste Management Strategy and the implementation of the ITER agreement in the area of waste.

Progress Report on Radiological and Environmental Monitoring Systems (REMS)

For the Radiological and Environmental Monitoring Systems (REMS), 2015 activities were mainly devoted to the development of the system preliminary design, limited to the tokamak complex (tokamak, tritium and diagnostics buildings), by delivering a set of reports as per the ITER System Design Process (SDP) Working Instruction.

The REMS I&C architectures have been frozen, and their main interfaces with the Central Safety System and CODAC were agreed upon and implemented. During the same period, a series of meetings between ITER IO/F4E REMS team and the ITER IO Safety Group were organised in order to discuss safety issues, specific defined requirements and their implementation in the REMS design as well as their integration with interfacing systems.

Radio and Microwave Heating Systems

F4E is responsible for the in-kind procurement of the following:

- Ion cyclotron resonance heating system (equatorial port plug incorporating one ion cyclotron antenna) (3.96 kIUA);
- Electron cyclotron resonance heating system (four upper port plugs incorporating launchers as Primary Confinement System (10.8320) kIUA), 100% of the Electron Cyclotron Plant Control and Upper Launcher sub-system Control Unit (1.4 kIUA).

Executive Summary

In the area of the radio and microwave heating systems, the main highlights during 2015 are as follows:

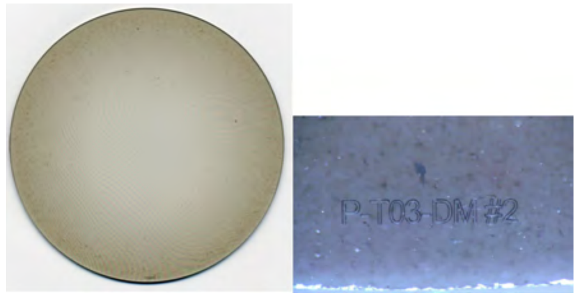
- The EU design of the gyrotron for ITER was pre-validated. This entails validating the most critical components of the EU 1MW gyrotron design with tests on a 1MW 170 GHz short pulse gyrotron compliant with the ITER specifications at short pulses, showing a broad operational domain, and on a specific mock-up to establish the limits of the cavity cooling for long pulses;
- The manufacturing, assembly and factory testing of the 1MW continuous-wave (CW) gyrotron prototype for ITER was successfully completed and the gyrotron prototype delivered to the Karlsruhe Institute of Technology (KIT) gyrotron test facility for installation and commissioning;
- The design review of the cryogen-free superconducting magnet, which will be coupled to the 1MW CW gyrotron prototype after its initial test at KIT, was performed successfully. This milestone was followed by the start of manufacturing;
- The power module prototypes for the European power supplies (PS) for the ITER electron cyclotron system have been successfully tested and the fabrication of the first set (out of eight in total to be delivered and installed) has started;
- For the Ion Cyclotron antenna, work has progressed on requirement capture and a new design plan agreed with ITER IO;
- The prototype of the ultra-fast protection against arcs was built and tested (Electron Cyclotron Control);
- For the Electron Cyclotron Upper Launcher, the qualification of the diamond disk (core component of the high power Electron Cyclotron window) was achieved. In addition, a complete revision of the design of the in-vessel and ex-vessel components was carried out to adapt to the changes in the environment.

Progress on the Electron Cyclotron Upper Launcher

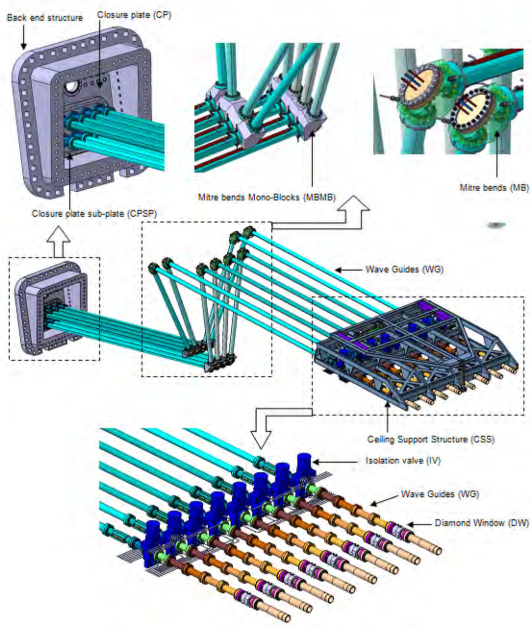
A complete revision of the Electron Cyclotron (EC) Upper Launcher design has been performed in collaboration with the ECHUL consortium (the members are: KIT (Germany), IPP (Germany), SPC (Switzerland), CNR (Italy) and DIFFER (The Netherlands). The work was required to accommodate important changes at the vacuum vessel interface, reducing the space available for the port plug, mm-wave components and services. Global engineering analyses (neutronics, thermo-mechanical, seismic, electromagnetic, structural) were carried out to evaluate the validity of the new structural design and to guarantee the overall integration with the optical system. In parallel the design of the first confinement system has advanced considerably, incorporating the results of engineering studies and previous testing (i.e. reduction of SIC-1 welds, improved design of mm-wave couplings and feedthroughs, new design for adjustable ceiling supports, consolidation of diamond window design and assembly procedures). The development of the first confinement system was supported by a detailed nuclear safety and failure mode analysis performed by NIER Ingegneria. The in-vessel optical design and structural integration have also advanced, taking advantage of in-depth analyses for assembly and maintenance operations. As a result the optical mirrors can now be installed and removed from the port plug outer wall, making the overall maintenance process faster and less prone to errors.

The last part of the year was dedicated to the evaluation of further Project Changes Requests (PCRs) requiring modifications of the launcher Blanket Shield Module (BSM) to ensure the maintainability of the wall mounted blankets without removal of the port plug. This change is likely to result in a substantial revision of the manufacturing scheme and cooling arrangement for the launcher BSM, as well as engineering adaptations of the mm-wave system (planned for 2016).

With regards to prototyping activities, there was significant progress for the EC Torus windows that will be used for the four EC upper launchers and one Equatorial launcher. By mid-2015, two diamond disks were fabricated by Diamond Materials and tested at the company and in KIT (Germany). The tests (dimensional, surface quality and loss tangent) were successful and the disks fabrication is now qualified.



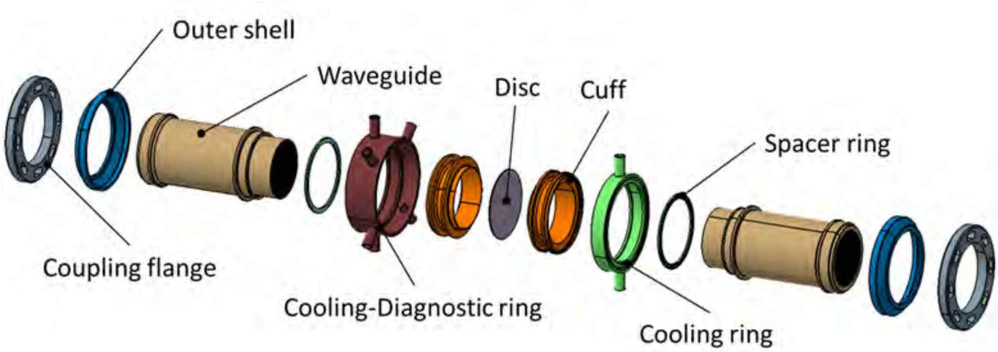
One of the qualified disks (left) and close-up of ID mark of the disk (right) – Diamond Materials (OPE 561).



EC Upper launcher ex-vessel system (GRT 161 – ECHUL consortium)

During the last quarter of the year, a new contract was signed for the manufacturing of two additional disks for mock-up production and brazing test. This contract includes the manufacturing of a Cu cuff to be brazed to one disk, brazing of the disks to the cuff and vacuum tests; further inspection, measurements and testing of the brazed units will be carried out at KIT. Within 2015, the two new disks were manufactured and sent to KIT for testing before brazing (to be carried out in 2016).

The design of the high-power EC window structure has progressed towards final design. The complex window design was optimise to reduce the number and type of welded joints and to align the design to the requirements of the relevant nuclear Codes (ASME III NC), especially regarding inspection (Non-Destructive-Testing, NDT). The new design of the window is illustrated in the 3D exploded view below, and will be used for the production of full-scale prototype for final qualification of the component in 2016 (the component is safety-relevant).



Exploded view of the diamond window assembly (ECHUL consortium).

Progress on the Electron Cyclotron Plant Control System

The work on the Electron Cyclotron Control system started in 2015 after signature of the relevant Procurement Arrangement at the end of 2014.

The activity focused mainly on the revision of requirements and on the definition of interfaces with the other subsystems.

To this purpose, a technical meeting was organised and held in Japan with the participation of all involved Domestic Agencies to discuss the overall architecture and the technological solution. The interface to the ITER Plasma Control System (PCS) was discussed with ITER IO and in large part fixed.

For the most critical hardware component, which has to implement ultrafast protection functions with a reaction time in the order of few µs, there is no viable solution in the ITER catalogue. To reduce risk, a prototype was built and tested in collaboration with the F4E Instrumentation & Control Group.

Progress on the Ion Cyclotron Heating

The framework contract for the final design of the ITER Ion Cyclotron Heating (ICH) antenna was signed in January 2014 with the CYCLE consortium (CYCLE consortium: CCFE (United Kingdom), CEA (France), ERM (Belgium), IPP (Germany) and Politecnico di Torino (Italy)). The design work is carried under an ITER Task Agreement.

A Shut-down Dose Rate (SDR) analysis of the ICH antenna in its environment was carried out in 2015 upon the request of ITER IO via a specific contract of the antenna design framework contract. The preparation and follow-up of the contract benefited from the technical support of F4E's Technical Support Services (neutronics). The analysis was aimed at evaluating the effect of Project Change Requests (PCR) changes to the in-vessel configuration, in particular increased gaps around the antenna and modified blanket configuration. The Shutdown Dose Rate (SDR) for the new configuration was found to be comparable or smaller to the previous 2013 analysis despite the larger gaps. This shows that the effect of larger gaps can be compensated by the Boron Carbide (B4C) front shim, inclusion of B4C in the vacuum vessel port extension and as a liner of the bioshield plug. The latter two are not in the baseline ITER configuration, whereas the front shim has been proposed via a PCR.

The first specific contract of the framework contract for the ICH antenna design produced a DOORS database with a critical review of the requirements as they appear in the ITER requirement documents. This work, which also produced a definition of the baseline documentation for the design, is being finalised.

During 2015 the Ion Cyclotron Resonance Heating (ICRH) teams of ITER IO and F4E jointly completed a planning exercise for the future technical evolution and development paths of the antenna design. This exercise included a systems' critical review in terms of design and strategy for the R&D and qualification of components which highlighted a number of areas where the design could be improved both in terms of expected reliability and reduction of manufacturing complexity. A development roadmap was agreed between the parties, the implementation of which will start early 2016.

The work to perform tests and analysis of active metal brazing of alumina grades to titanium (Ti), as used in the Radio Frequency window design, has been completed. The tests identified the best active braze material and showed that it is possible to produce alumina to Ti brazed samples with the required strength and vacuum tightness. With copper-plated (Cu) Ti (as in the antenna design), the results were less encouraging. Further tests with different methods of deposition of Cu on Ti are foreseen for 2016.

Progress on the Electron Cyclotron Radio Frequency Sources and Power Supplies

The 1MW, 170 GHz short pulse gyrotron manufactured by KIT in collaboration with Thales Electron Devices GmbH (TED), was tested in 2015 by the European Gyrotron Consortium (EGYC) (which consists of several European Fusion Laboratories (EFLs), namely KIT - Germany, SPC (formerly CRPP) - Switzerland, HELLAS

- Greece, CNR - Italy, and USTUTT- Germany, and ISSP - Latvia as third parties) in the KIT gyrotron test facility. This gyrotron has the same design of the electronic and Radio Frequency (RF) components as the 1MW, 170 GHz industrial CW gyrotron for ITER, but a simpler construction due to its limited cooling needs. The experiments have shown that the short pulse gyrotron, operating at pulses of a few ms, is able to produce >1 MW of output power (up to 1.4 MW has been achieved) at the nominal oscillation mode TE32,9 and at the right frequency, in stable and reproducible conditions and in a broad operational domain. The electronic efficiency and the quality of the output beam are well within the specifications. The results have therefore verified the design of the key gyrotron components from the RF performances viewpoint.

The limits and safety margins of the cooling techniques used in the highest heat flux gyrotron components have been assessed via 3D thermo-hydraulics computational analysis, and improvements have been identified. For the gyrotron cavity, which is subject to heat loads >20 MW/m^2, a specific mock-up of the current cavity concept has been manufactured and first tests performed in 2015 in the high flux FE200 test facility of AREVA in Le Creusot, France, showing that the temperature of the targeted surface stays below the design values for the possible operational heat loads.

The manufacturing and assembly of the 1MW CW gyrotron prototype for ITER was successfully completed by Thales Electron Devices, and the CW gyrotron passed the final Factory Acceptance Tests.

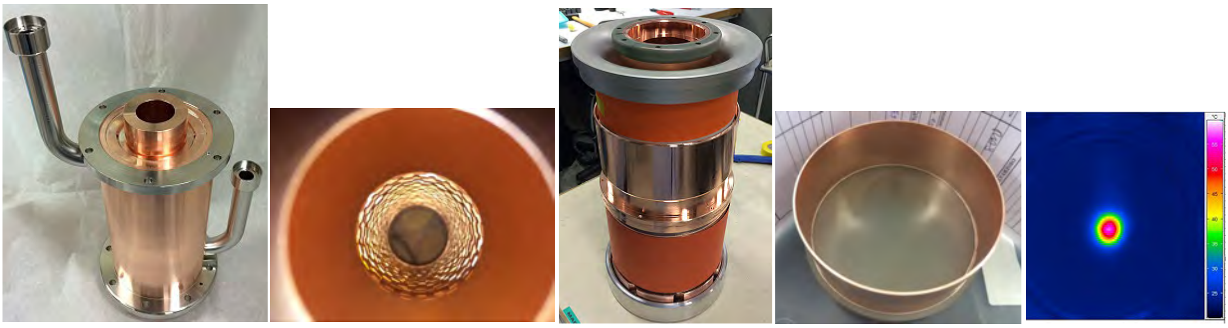
The short pulse (left) and the CW (right) EU gyrotron prototypes

Detailed controls of the critical fabrication steps have been established also in view of the industrialisation and series production phases (with EGYC, with KIT and with Tecnalia). Like the short pulse gyrotron, the CW prototype incorporates novel concepts developed by EGYC to improve further the quality of the electron beam for an efficient RF generation and of the output RF beam, which is important for an efficient transmission and launching of the RF waves into the plasma, while making an optimal use of the technical heritage in Europe of the successful series production of gyrotron tubes for the W7-X stellarator. With the Factory Acceptance Tests completed, the gyrotron prototype was delivered to the KIT gyrotron test facility for installation and commissioning, bringing F4E closer to the critical phase of validation of the European gyrotron for ITER in 2016, when the full-power and long pulse RF tests will be performed.

The gyrotron modelling and design efforts continued in 2015 by EGYC with the focus on the optimisation of the gyrotron performance, upgrades of the test facilities and the development of a conceptual design of the Matching Optics Unit.

The contract with Cryogenic Ltd was signed in March 2015 to produce the first-of-its-kind European superconducting magnet prototype for the EU gyrotron for ITER. The design of the superconducting magnet, which will use the cryogen-free cooling technology required for ITER, was successfully completed, and the procurement of superconducting wire for the prototype has been initiated. The prototype will be delivered in autumn 2016 to the EPFL-Swiss Plasma Center (SPC) gyrotron facility for extended tests with the 1MW CW gyrotron prototype.

With the closure of the Final Design Review of the European EC HV power supply (PS) system for ITER, specific qualification activities were performed in 2015 by Ampegon AG on two prototypes of power modules for the Main (cathode) HV PS and Body PS, including functional, performance, thermal and EMC tests. While the results showed compliance with the specifications, some further improvements were identified and incorporated in the manufacturing definition file to increase the engineering margins, and the procurement of parts started as planned. The start of the final Factory Acceptance Tests of the first PS set of the total eight sets for ITER is expected in 2016.



Subassemblies of the 1MW CW gyrotron prototype: the beam tunnel external and internal sides, electron gun, collector, and the output diamond window; and the IR image of the output window from the short pulse gyrotron showing a high Gaussian mode content of the output microwave beam (~98%).

The prototype of the Main HV PS power module

Neutral Beam Heating

F4E is responsible for the in-kind procurement of the Neutral Beam (NB) Heating system (100% assembly and testing, 100% beam line components, 100% of compensation and active correction coils, around 50% of the remaining components broken down into:

- Neutral Beam assembly and testing (3.8 kIUA);
- Beam source and high voltage bushings (3.893 kIUA);
- Beamline components (3.9 kIUA);
- Pressure vessel and magnetic shielding (9.025 kIUA);
- Active corrections and compensation coils (4.4 kIUA);
- Neutral Beam power supplies and related systems (31.382 kIUA);
- Neutral Beam Test Facility (27.0 kIUA)

F4E is in charge of the in-kind contributions related to seven procurement packages for the Heating Neutral Beam Injectors beam sources, beam line components, confinement and shielding, coils, power supplies, assembly and the Neutral Beam Test Facility (NBTF) in Padua, Italy, covering a wide range of procurements of different nature.

Executive Summary

In the area of the Neutral Beam Heating Systems, the main highlights during 2015 are as follows:

- All necessary construction area has been handed over to F4E, and the installation activities related to all the contracts for the construction of the SPIDER experiment and PRIMA auxiliaries have started;
- The SPIDER vessel has been delivered, installed, tested and completed with the installation of vacuum system from a different supplier;
- The High Voltage Deck (HVD) has been installed and tested;
- The installation of SPIDER power supplies inside the High Voltage Deck (HVD) have been completed;
- The equipment for the control system has been procured;
- The contract for the acceleration grid power supplies (AGPS) has been signed;
- The contract for the ground related power supplies (GRPS) has been signed;
- The Call for tender for the MITICA beam source, the core component of the ITER injector, has been launched;
- The Service Framework contract for NBTF site supervision has been signed;
- The completion of the extensive grant, under the ITA, for the design of components for ITER not subjected to testing at the NBTF.

Progress Report

The NBTF entered the construction phase in 2012, with the start of the works for the erection of the buildings in Padua, and have progressed well. The buildings, managed by Consorzio RFX, are part of the Italian contribution to the establishment of the NBTF.

The organisation of the construction site was finalised in 2014, and allowed the concurrent execution of works by Consorzio RFX, F4E and other ITER Domestic Agencies. This has allowed the F4E contractors to continue the on-site installation activities during 2015.

Moreover, F4E continued to provide support to ITER IO to prepare the Heating Neutral Beam (HNB) technical specifications at the required level of detail. This support included most of the design and R&D activities related to the NB Heating System and the design and the establishment of the NBTF. In particular:

- The ITER Task Agreement (ITA)/grant for the design of ex-NBTF components for ITER, originally signed in 2012, was completed and closed in April 2015 with the finalisation, at the required level of detail for Procurement Arrangement signature, of the design of the Beam Line and Beam Source vessels, the Passive Magnetic Shield and Active Correction and Compensation coils, the Drift duct and Fast shutter. In addition, still in the scope of the ITA/grant, the Final Design Review for the Duct Liner, which will be procured by the Korean Domestic Agency, has been successfully held in February 2015. All the deliverables have been provided to ITER IO;

- The installation activities for the NBTF cooling plant supplied by Delta-Ti Impianti S.p.A. progressed throughout the year;

Installation of the cooling towers on top of the roof of Building 2 at the NBTF

- The SPIDER High Voltage Deck was installed, tested and finally accepted by F4E in 2015;

The SPIDER High Voltage Deck during tests

- The SPIDER Transmission Line was manufactured, tested in the factory and delivered to the site. The installation will start beginning of 2016;

The SPIDER Transmission Line during the assembly at the NBTF

- Two contracts were signed for the supply of the acceleration grid power supplies and ground related power supplies with NIDEC ASI and OCEM respectively;

- The contract for ISEPS with OCEM Energy Technology: The SPIDER unit was installed and commissioned. Site testing is ongoing, with view to completion by Q1-2016. The MITICA unit design is ongoing, with layout adaptation to the High Voltage Deck of MITICA being carried out;

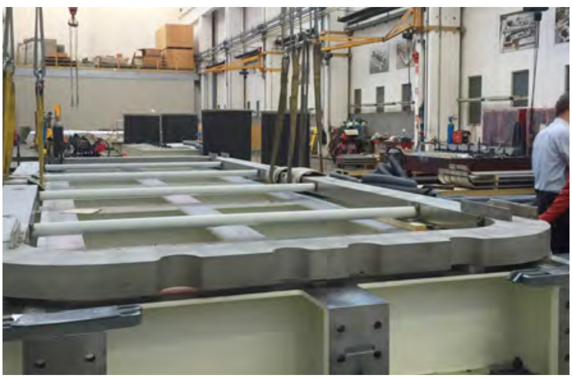
The ISEPS installation at the NBTF site in Padua, Italy

- The contract for HVD1 and Bushing with SIEMENS: The contract started in January with the MITICA unit, with preliminary and detailed design carried out during the course of 2015, concluded by a successful design review in December. ITER units were released in line with contract terms in November 2015;

- Manufacturing of the MITICA vacuum vessel started after the completion of the Manufacturing Design Review, with preparation of the manufacturing drawings and procurement of the material;

- The contract for SPIDER & MITICA G&V – The SPIDER experiment delivery & installation of equipment/ components for the vacuum plant, cooling system, N2 and H2 gas distribution and electrical plant has started;

- An offer from Consorzio RFX was received for the negotiated procedure with single tenderer for the NBTF Assembly Framework contract. Negotiations were conducted with Consorzio RFX after review of the offer;
- The technical specifications for the MITICA beam source were completed and the Call for tender was launched; The technical specifications for the SF6 contract were completed and the Call for tender was launched;
- The final draft of the technical specifications from Consorzio RFX for the MITICA Beam Line Components was received;
- The SPIDER vacuum vessel, was delivered and tested. The electrical bushings were also partially delivered;
- The manufacturing of the SPIDER beam source progressed well during this period.



Welding on the BLV Top Flange in the building dedicated to the MTTICA vessel at the supplier's premises

General overview of on-going installation of the vacuum system inside the SPIDER bio-shielding

The SPIDER vacuum vessel inside the bio-shielding

The SPIDER beam source components ready for assembly

Diagnostics

F4E is responsible for the in-kind contribution of ten distinct diagnostic systems, which comprise about one quarter of all ITER diagnostics scope. Additionally, F4E's diagnostics-related contributions include Tokamak Services (in-vessel cable looms, connectors and feedthroughs for EU and non-EU diagnostics), integration design of diagnostics into seven ports housing 22 diagnostics systems from F4E, ITER IO Central Team and five other ITER Domestic Agencies, as well as supply of supporting structures and radiation shielding modules in five of these ports.

During 2015, with contracts or grants in place for activities on most of the major systems, and more than 28 laboratories and industry players involved from 12 EU countries, the work on Diagnostics systems is making headway.

Executive Summary

The main highlights during 2015 are as follows:

- System-level design activities have defined the system architecture, subsystem requirements and interfaces for most of the Diagnostics systems and for their integration in two of the EU ports. In several cases baseline designs have been established following a rigorous selection process;

- Prototyping programmes for many diagnostics are up-and-running, addressing the feasibility, performance and manufacturability of a wide variety of components;

- Magnetics Diagnostic: The first of series Continuous External Rogowski coil components have been manufactured and successfully passed tests in the factory;

- Tokamak Services for Diagnostics: In-Vessel electrical wiring maps have been completed, providing detailed routing and related information for more than 2000 individual in-vessel cables;

- Optical systems – first mirrors: Promising results have been achieved in lifetime optimisation studies using Radio Frequency (RF) cleaning, showing very minor changes in specular reflectivity after several cycles of material deposition followed by RF cleaning.

Progress Report

Low temperature co-fired ceramic (LTCC) magnetic sensors

The production of LTCC sensor prototypes, which represent one of the main types of magnetics sensors on ITER, has started. The design is being optimised through analysis and by production of 120 prototypes in eight design variants; with different wiring schemes and electrical screen thicknesses.

Each prototype consists of 34 layers of ceramic, 30 of which contain a screen-printed spiral coil circuit made out of pure silver (the remaining layers of ceramic provide external protection and electrical screening in the form of a printed grid on the external faces of the device). The individual spirals, which have a width of 400 μm and a height of 12 μm, are connected together with inter-layer 'vias' so that the whole assembly forms a single pick-up coil. The manufacturing technology is

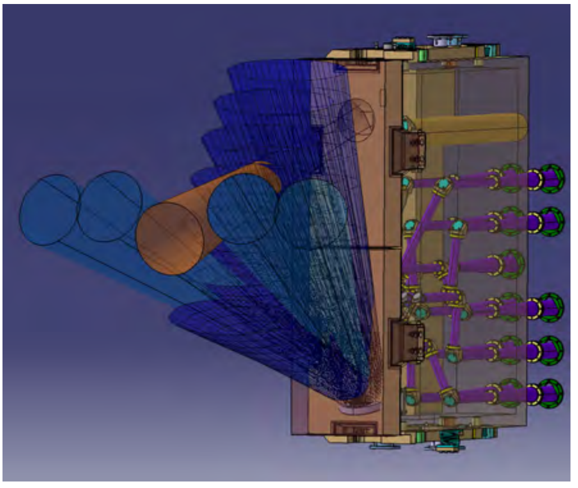
One of the LTCC sensor prototypes manufactured by Via Electronic GmbH termed “Low-Temperature Co-fired Ceramic” (LTCC) and offers a very robust product because the sensor is fully encapsulated in ceramic.

More than 200 such sensors will be installed in the vacuum vessel and will measure the local magnetic field in ITER during operation, contributing vital information for control of the plasma.

Collective Thomson Scattering (CTS)

The Collective Thomson Scattering (CTS) diagnostic system will measure densities and velocities of the confined fusion alpha particles and fast ions in ITER plasmas. A system architecture of the port plug-based components has been baselined during 2015. The design envisages a launcher line to couple microwaves from a source to two mirrors, which launch them into the ITER plasma. Two receiver mirrors collect the microwaves scattered from the plasma and transmit them along seven receiver lines, with different views of the plasma, to detectors. Interfaces and technical requirements of the system were also defined.

This work was undertaken under a grant signed with a consortium of DTU, Denmark, and IST, Portugal. It was completed in line with tight schedules driven by integration of the port plug hosting the CTS front end, which is being integrated by the Chinese Domestic Agency and is needed for first plasma on ITER.



CAD model of the CTS front-end

Plasma Position Reflectometry (PPR)

The Plasma Position Reflectometer (PPR) diagnostic will use reflections of microwaves to measure the position of the plasma edge at four different locations around the plasma. A system architecture, technical requirements and interfaces of the PPR diagnostic were defined in 2015 and R&D for several components of the system was initiated.

R&D of in-vessel components (i.e. transmission lines and antennas) at two of the measurement locations is progressing within a grant signed in July 2015. The scope of this grant also includes microwave testing of critical components. Under the grant, IST Portugal established an microwave test facility and tested a range of reflectometer antennas; in order to validate modelling tools that will be used to design the antennas for ITER.

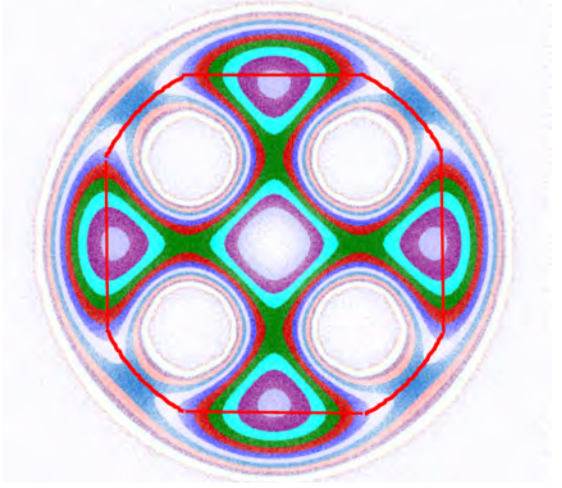
Another grant was signed with CIEMAT, Madrid, and CNR, Milan, for design of in-port-plug components serving the other two measurement locations and of ex-vessel transmission lines for all four locations. The components are needed early in the construction of ITER.

CAD model of the CTS front-end

Tokamak Electrical Services

Tokamak Services for Diagnostics provide the electrical infrastructure to serve diagnostic sensors installed in the ITER vacuum vessel. This infrastructure is composed of cabling, feedthroughs and connectors.

With regard to cabling, CAD drawings and in-vessel electrical wiring maps were completed by the Wigner Institute, Hungary, and provide detailed routing and related information for more than 2000 individual in-vessel cables. Additionally, first results of modelling of radiation-induced electrical disturbance in mineral insulated cabling were obtained by SCK-CEN, Belgium, to assist with interpretation of results from irradiation testing, to be conducted under a second contract which has been signed with SCK-CEN. Extensive preparatory work for design of feedthroughs was carried out during 2015 by the Wigner Institute. This included definition of interfaces, preliminary CAD models and elaboration of a comprehensive requirements database, containing around 800 requirements and using state-of-the-art systems engineering tools.



Calculated space charge potential profile for the quad-core MI cable

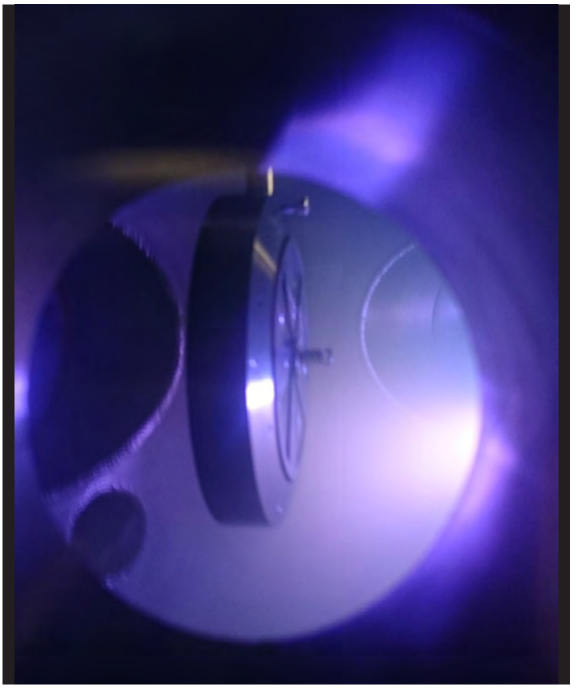
With regard to connectors, in particular those located in diagnostics divertor cassettes with remote handling capability, a grant was signed with VTT, Finland. Under this grant a functional breakdown analysis and a requirements database, again using state of the art systems engineering tools, have already been delivered.

First Mirror lifetime optimisation

F4E has the responsibility for three optical diagnostics in ITER: an Equatorial Visible/IR Wide Angle Viewing System (WAVS), a Core Plasma Charge Exchange Recombination Spectrometer (CP CXRS) and a Core Plasma Thomson Scattering system (CPTS).

In all these systems First Mirrors (FM) are located close to the diagnostic first wall entrance and are therefore exposed to energetic particles emitted from the plasma. Over time, this exposure can induce erosion or deposition at the surface of the FM leading to substantial loss of specular reflectivity and hence degradation of diagnostic performance. In the past, various cleaning techniques aimed at mitigating the effects of deposition on the mirrors were investigated and Radio Frequency (RF) cleaning was identified as the most attractive candidate for use in the ITER environment.

In 2015 F4E undertook R&D to investigate this technique further. A contract was placed with the University of Basel (UB), Switzerland, to perform a first set of tests focusing on possible degradation of optical properties after repetitive RF cleaning and possible etching effects when applying the technique on non-homogeneous deposits.



Mirrors being cleaned by RF plasma

A variety of mirror samples (corresponding to possible FM candidates) were manufactured at UB and four industrial suppliers. Around 100 samples were produced, using several manufacturing techniques including magnetron sputtering, pulsed laser deposition and electron beam evaporation. The ultimate goal is to establish which material(s) and manufacturing techniques are the most suitable for use as a first mirror on ITER when exposed to repetitive RF cleaning.

First results with samples manufactured by UB are very positive, demonstrating that RF cleaning can deliver near complete recovery of specular and diffuse reflectivity after 10 deposition-cleaning cycles on selected mirror samples. The tests will continue until 20 cycles have been completed.

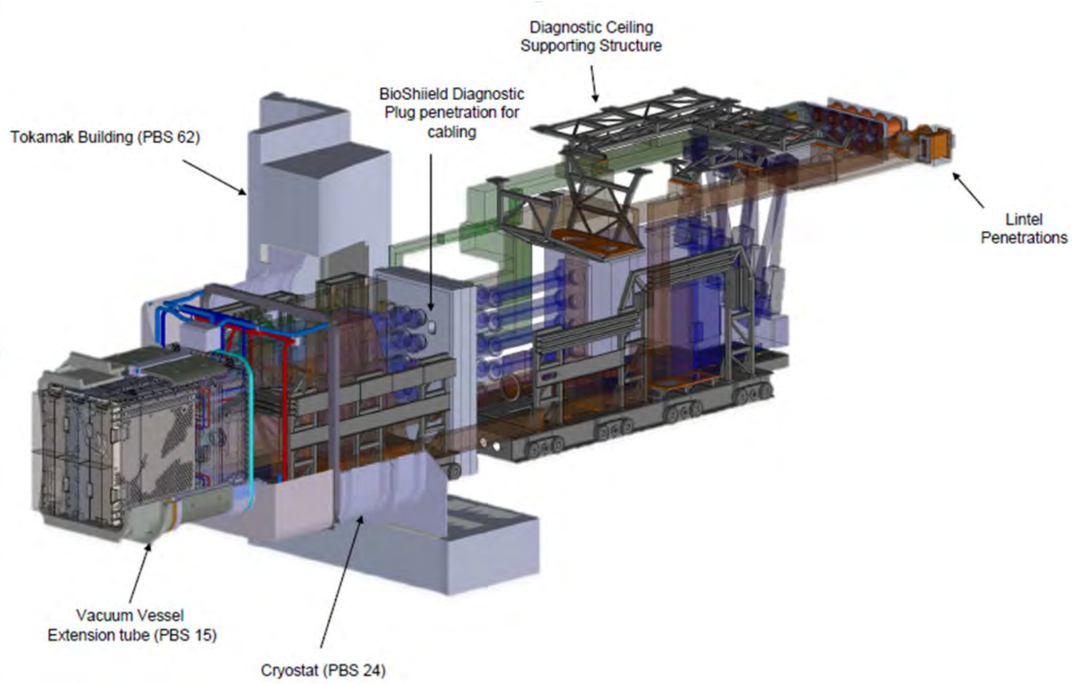
Diagnostic ports integration

In 2015, the integration design of diagnostic ports, conducted by F4E under a framework contract with IDOM Ingeniería y Consultoría, Spain, has progressed substantially.

A diagnostic port integration strategy was defined, based on a rigorous systems engineering approach, and presented to project stakeholders: ITER IO Central Team and diagnostics designer teams from the ITER Domestic Agencies, including F4E, in order to secure buy-in of all stakeholders.

The strategy was then implemented on two of the five ITER ports under EU scope of integration supply, leading to definition of system architectures and specifications; establishment of baseline designs; preliminary identification of interfaces in collaboration with the diagnostic designers and ITER IO Central Team; initial designs for port plugs, port interspaces and port cells systems; and validation assessment via end-to-end engineering analyses loops.

In addition, the baselining and preliminary identification of interfaces was started for the other three ports in collaboration with the tenants, and concepts were designed for the specific components affecting port integration, such as the port-mounted electrical feedthroughs, which are a containment barrier and thus safety important components.



Equatorial Port 10: overview and surrounding environment

Test Blanket Modules and Materials Development

The operation of Test Blanket Module (TBM) systems installed in ITER will demonstrate the feasibility and performance of the tritium breeding blankets of future fusion reactors (tritium is necessary for the fusion reaction to occur). This information is needed before a DEMO reactor can be designed, constructed and operated.

Since the late 1990s Europe has been developing two concepts of TBM for ITER: the Helium-Cooled Pebble-Bed concept (HCPB) and the Helium-Cooled Lead-Lithium (HCLL). Both concepts share similarities in terms of design, structural material and technologies. However, the key difference lies in the type of tritium breeder material used: for the HCPB, lithium is present in ceramic pebbles, whereas for the HCLL, it is implemented under the form of liquid lead-lithium alloy.

Executive Summary

The main highlights during 2015 are as follows:

- The Conceptual Design Review of the HCLL and HCPB TBM systems has been completed. The propagation of ITER requirements and interfaces down to the detailed level of sub-systems has been initiated as preparation of the Preliminary Design phase;

- A consulting contract with an Agreed Notified Body for certification of Nuclear Pressure Equipment (NPE) has confirmed the classification of the TBS with regard to the French regulation for NPEs. The roadmap to the certification of the TBM has been established taking into account the innovative nature of its design and structural material;

- R&D activities in support to the design of the TBM Systems have been pursued, in particular with experimental activities for the validation of performance of key technologies of ancillary systems (helium turbo-circulator, tritium extraction, etc.) and the development of specific sensors to be installed in the TBM box. Two Framework Partnership Agreements have been also signed for developing specialised modelling tools to be used for detailed design of the TBM or exploitation of TBM test results in ITER (e.g. Magneto-Hydrodynamics, Thermal-hydraulics, etc.);

- Campaigns for irradiation of the TBM structural material, the EUROFER steel, have been launched, focusing on the lower/upper ranges of the TBM operating conditions where specific irradiation effects need to be further characterised and quantified. In order to pursue the integration of the EUROFER steel in the French nuclear construction code RCC-MRx, two Framework Partnership Agreements have been signed, and first specific grants were launched focusing on establishing a work plan for development of specific design rules for EUROFER and Small-Scale Tensile Test technology;

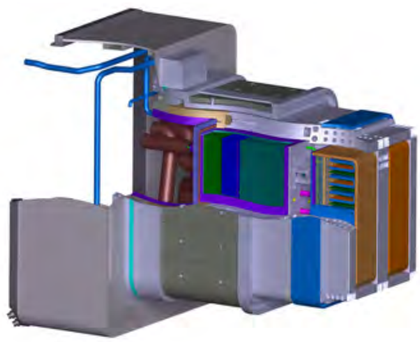
- A set of three accidental analyses for each HCLL and HCPB TBM systems was achieved, run with the MELCOR and RELAP 5 simulation codes. These result will be used for the TBM Systems safety demonstration in preparation by ITER IO to the French Nuclear Regulator;

- The standardisation of the fabrication procedures for the subcomponents of the HCPB and HCLL TBMs (e.g. internal cooling plates, First Wall & Side caps) was achieved. A contract has been launched to standardise the assembly procedure of these subcomponents by welding to form the TBM box;

- A contract has been signed for the procurement of 25 tons of EUROFER steel according to its RCC-MRx specification; these products will be used for fabricating the future Qualification and Prototypical mock-ups of the TBM Box.

Progress Report
Progress in the Design of the TBM Systems

The Conceptual Design Review (CDR) meeting for the European TBM systems was organised jointly with ITER IO. It pointed to the need for ITER IO to further consolidate its requirements and the management of tritium permeation in the ITER Port Cell where TBM will be installed. To achieve this objective, the on-site collaboration with ITER IO has been reinforced. In addition a Memorandum of Understanding has been signed between F4E and ITER IO for the transfer of responsibility of the final design and procurement of TBM systems connection pipes to be installed in ITER during the tokamak building construction phase.



Two European Test Blanket Modules and their radiation shields installed in the ITER Port Extension #16 (IDOM)

Qualification of EUROFER structural material

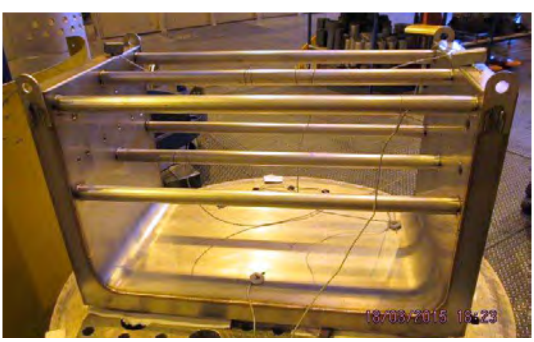
The EUROFER steel is a reduced-activation steel that has been specifically developed for fusion nuclear applications. It will be used as the structural material for the TBMs to be tested in ITER. In order to guarantee the mechanical resistance of the TBM box under neutron irradiation, two contracts for irradiation of EUROFER samples has been launched in the lower and higher ranges of the TBM operating temperature (STUDSVIK).

These contracts will allow completing the database of mechanical properties for irradiated EUROFER and integrating corresponding design limits in the nuclear construction code RCC-MRx. For that purpose, two specific grants have also been signed with French Alternative Energies and Atomic Energy Commission (CEA)/Karlsruhe Institute of Technology (KIT) in the area of EUROFER qualification and design rules development.

Standardisation of TBMs box fabrication

The fabrication of standardised and near full-size mock-ups of five TBM sub-components were achieved successfully by industry and European Fusion Laboratories (EFLs). In parallel, a technical development plan for the assembly of these TBM sub-components by welding to form the complete TBM box was completed by ATMOSTAT.

The contract for the procurement of 25 tons of EUROFER plates has been signed with in prevision of future fabrication of the TBM qualification and prototypical mock-ups. For the first time, EUROFER plates will be procured and fabricated following the specifications of the nuclear construction code RCC-MRx.



Half-size mock-up of TBM first wall realised with standardised welding procedure specifications (ATMOSTAT, CEA). Cooling channels meandering in three dimensions are reconstructed by mixed laser/diffusion-bonding process.

Half-size mock-up of TBM first wall realised with standardised welding procedure specifications (ATMOSTAT, CEA), after removal of the canister and machining; final tolerances are within specifications.

Closure of side caps onto the first wall for the realisation of a TBM box one-third mock-up (ATMOSTAT)

Development and qualification of TBM systems instrumentation

The instrumentation foreseen for each sub-system has been systematically identified in terms of possible location, operative conditions and functional requirements (TBM Consortium of Associates). When needed preliminary tests in available facilities have also been identified. As part of the outcome, the test of commercial or customised sensors for single effects (i.e. temperature) was proposed for all classes of sensors not certified for TBM operative conditions. Prototype development was proposed for instrumentation for which commercial technology was not applicable. An outstanding example in this sense is the application of high-temperature, radiation resistance optical fiber sensors, in particular based on Fiber Bragg Gratings (FBG) technology, to measure temperature and strain in the TBM structure.

A second specific grant has been signed for the development of specific sensor types: i) Development of optical fiber sensors based on regenerated Fiber Bragg Gratings (FBGs) to measure temperature and strain of TBM structural components during ITER operations the scope; ii) Development of resistive strain gauges for TBM structural components; iii) Development of a system to measure global forces on the TBM by strain gauges on attachments based on the force reconstruction method; iv) Development of thermocouple sensors to measure temperature of the TBMs structural components and electric field potential in the HCLL liquid metal breeder (TBM Consortium of Associates).

Modelling of TBM systems performances

A Framework Partnership Agreement has been signed for the development of simulation tools in the area of helium thermo-hydraulics. Another Framework Partnership Agreement has been signed for the development of simulation tools in the area of thermohydraulics, MHD, chemistry of Pb-16Li and tritium transport.

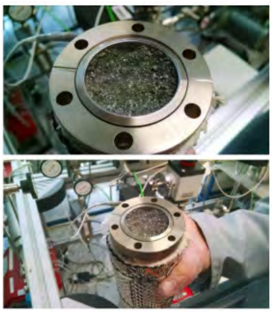
Technical activities on setting up a tritium transport simulation tool based on the EcoSimpro platform have been concluded (CIEMAT/EMPRESARIOS AGRUPADOS). Even if some limits exist, this tool is a significant improvement with respect to the analytical models used so far as it allows a dynamic simulation and it is more comprehensive in terms of transport physics modelling because it takes into account surface effects at cooling plates interfaces.

R&D in support to design development

In the area of R&D supporting the design development of TBM Systems, the following activities have been carried out in 2015, in collaboration with the TBM Consortium of Associates:

- Experiments carried out in Heloka (KIT) on the He compressor characterisation, in TLK (KIT) on PERMCAT device, in MELILOO (NRI) on PbLi cold trap performance study have been achieved.
- R&D activities started in the area of experimental validation of liquid metal systems design and characterisation of hydrogen/metal interfaces.

- In the area of experimental validation of the design of tritium components (Q2 getters, PTSA and reducing beds) the preliminary analysis of ZrCo material for tritium getters was completed, and test of beds with TBS relevant size started. The construction of a new experimental facility for the test of Coolant Purification System components also started, while the design and fabrication of the components to be tested was completed.
- First experimental results have been obtained in TRIEX facility (ENEA-Brasimone) on the performance characterisation of a packed column for tritium (hydrogen) extraction under flowing Pb-16Li. These preliminary results shall be further consolidated with a more comprehensive experimental campaign.



(a)

(b)

(c)

(d)

R&D activities at facilities of KIT and ENEA for performance characterisation of TBM systems key technologies/components:
(a) Characterisation of Tritium getter (ZrCo); (b) Characterisation of an isolation valve (helium loop); (c) MHD pressure drop TBM mock-up; (d) Operational domain of a helium Turbo-circulator K300 (ATEKO).

Safety and accident analyses

Accident analyses have been carried out and the main outcomes include developing and applying comprehensive methodology for accident analyses to HCLL and HCPB TBM systems (AMEC Foster Wheeler, Idaho National Laboratory). Also, TBS MELCOR and RELAP5 accidental models have been developed and extensively qualified against final element analyses, a number of test cases, scenarios and code-to-code comparison. Three key accidental scenarios have been simulated for each of the HCLL and HCPb TBM System: 32h Loss of Offsite power; LOFA accidents due to helium circulator failure; LOFA accidents with aggravating failure consisting in in-TBM box LOCA.

The MELCOR v.1.8.5 code has been also used to simulate the PbLi draining from the TBM taking into account MHD effect. Promising results have been obtained. The study shall continue with testing the newly released MELCOR v.1.8.6. This version consolidates all fusion features of MELCOR code and shall be further used for TBS analyses.

Radwaste management

Based on the radwaste classification achieved in 2014, CEA and Agence ITER France (AIF) have discussed with ANDRA regarding the acceptability of the TBM systems radwaste for final disposal. F4E has supported the study with technical information delivered to ANDRA for establishing a first feasibility report. No major issue has been pointed out by ANDRA concerning acceptability of this radwaste. Complementary technical studies are needed and will be carried out in 2016, in particular related to pre-treatment needs.

Technical Support Activities

Introduction

The Technical Support Services (TSS) Team performs a number of technical activities which support the ITER project work and cover the following areas:

- Analysis and Codes;
- Materials and Fabrication;
- Instrumentation and Control;
- Metrology;
- Drawing Office.

Analysis and Codes

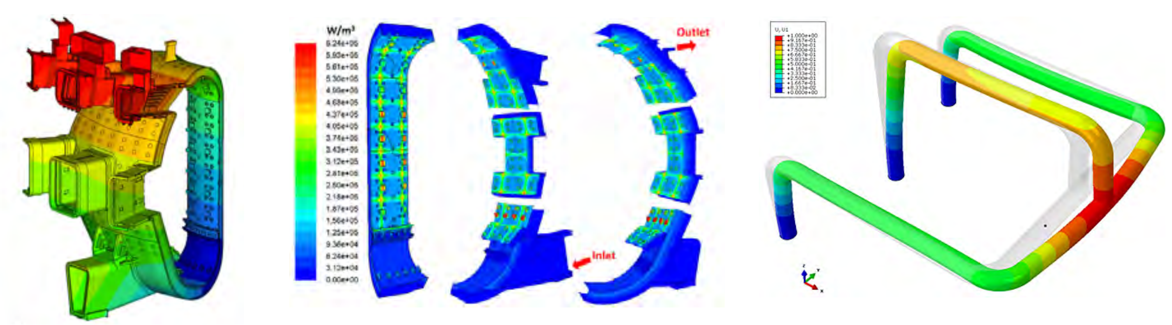
The activities focused on providing technical support in the area of computational analysis to the development of the ITER design as well as to the F4E procurement contracts by placing and following up service contracts to qualified companies as well as internal analysis activity.

The vacuum vessel regular sector 5 and irregular sectors 4 and 3 mechanical models were developed to justify to ITER IO and Agreed Notified Body any potential deviation and non-conformity that may arise during manufacturing. These models are a powerful tool to understand the global and local behaviour of the vacuum vessel and allow fast modifications to assess local safety factors.

Thermo-fluid-dynamics analyses of the gyrotron cavity mock-up and of the vacuum vessel sector 5 were also carried out. The first analysis involved the computation of bi-phase fluid and a benchmark with experimental results to better tune the model, whereas the second involved the development of a mesh of around 200 million cells to evaluate the temperature field due to the nuclear heat load. Thermal analyses of Toroidal Field (TF) Winding Pack (WP) cooling were also performed to study possible failure cases due resin de-bonding from the TF case cooling pipes.

Electromagnetic analyses were performed to assess the effect on error fields of likely vessel steel magnetic permeability variations due to manufacturing, the electric field distribution in the cooling pipes of the gyrotron HV feedthroughs, the thermo-electro-mechanical analysis of the 6.77 Tesla gyrotron magnet system, electromagnetic loads in the diagnostic port plugs and TBM system, magnetic measurements for the characterisation of TF coils, the benchmark of different techniques to map electromagnetic forces across different meshes and the development of a coupled code for electro-mechanical analysis including magnetic damping effects.

A nuclear shielding analysis of the ICRH antenna was performed to include the latest configuration changes, the results supporting the need for further improvements



Vessel sector 5 displacements (left) during a VDEII, its nuclear heat for 500 MW scenario (centre) and MECOS piping systems under benchmark analysis: example of computed eigenmode of the integrated shielding design of the ITER tokamak. Several tasks were also undertaken to complete the modelling of tokamak responses needed to update the estimates of integral and local heating in the vacuum vessel and TF coils and to compute the radiation fields in components such as port plugs, port inter-spaces, etc. A study of nuclear responses in diagnostics EP10 was completed and a shielding configuration was proposed which is able to reduce the shutdown dose rate levels in the inter-space by several orders of magnitude with respect to the baseline. A nuclear data validation experiment on a bulk Cu assembly was successfully performed at FNG (ENEA Frascati) with high quality measurements which provided valuable input for improvements of nuclear cross-section data.

Since ITER has to comply, as any nuclear facility, with stringent seismic requirements, Tokamak Building and Ancillary Buildings seismic floor response spectra were derived in close collaboration with ITER IO. Many analyses were also dedicated to study interface loads between components, in particular the one connecting the cargo-lift to the remote handling cask. F4E with its suppliers specialised in seismic engineering (e.g. EYSTECO) are also participating to international benchmarks organised under the auspices of OECD-NEA and related beyond design seismic analysis and justification of hard core components, namely the MECOS benchmark for the assessment of fatigue and ratcheting of piping systems and the CASH benchmark for the assessment of the seismic capacity of reinforced concrete shear walls.

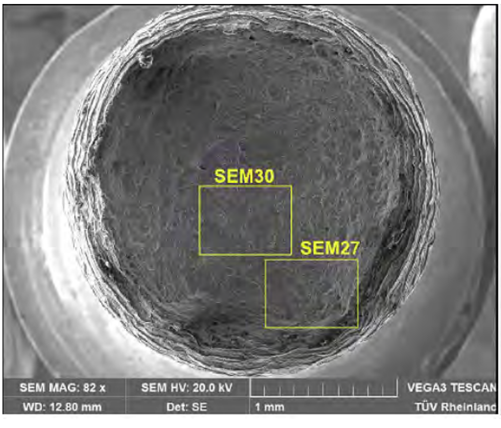
A TSS initiative to strengthen nuclear shielding and radiological protection integration in the ITER projects was positively answered by the ITER IO Central Team.

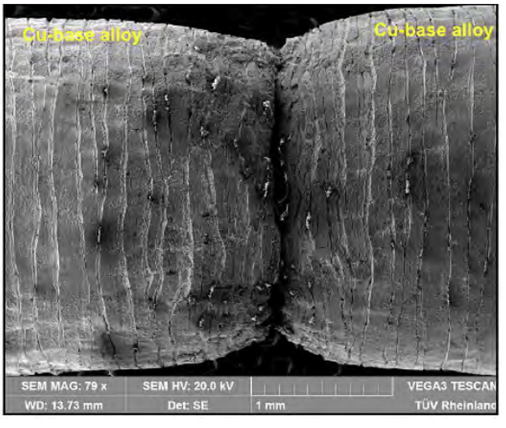
Materials and Fabrication

The 2015 activities in this area included characterisation and assessment of materials data under ITER operational conditions via irradiation campaigns, materials development, testing at cryogenic, room and elevated temperatures, thermal fatigue testing and assessment of corrosion parameters.

2015 saw as well an initiation of large number of qualification testing programme of full scale mock-ups for ITER and JT-60SA subcomponents at their operating conditions. These mock-ups were part of official qualification programmes of the component manufacturers, but part of the testing responsibility was shared with F4E and the suppliers. A major part of these tests were performed by Karlsruhe Institute of Technology (KIT), Germany, and Tecnalia, San Sebastian, Spain, through framework contracts. The first mock-ups, such as the ITER Poloidal Field (PF) coils He Inlet, JT60-SA TF coils He Inlet, and vacuum vessel bolted connection, etc. were successfully qualified.

A framework contract signed with TWI (The Welding Institute, United Kingdom) allows F4E to develop, test and control particular welding technologies useful for ITER component manufacturing. An issue related to plasma engineering was to find brazing techniques for various types of alumina (ceramic) and copper-plated titanium.





Thermal Creep Test specimen of CuCrZr after irradiation to 0.7 dpa.

Instrumentation and Control

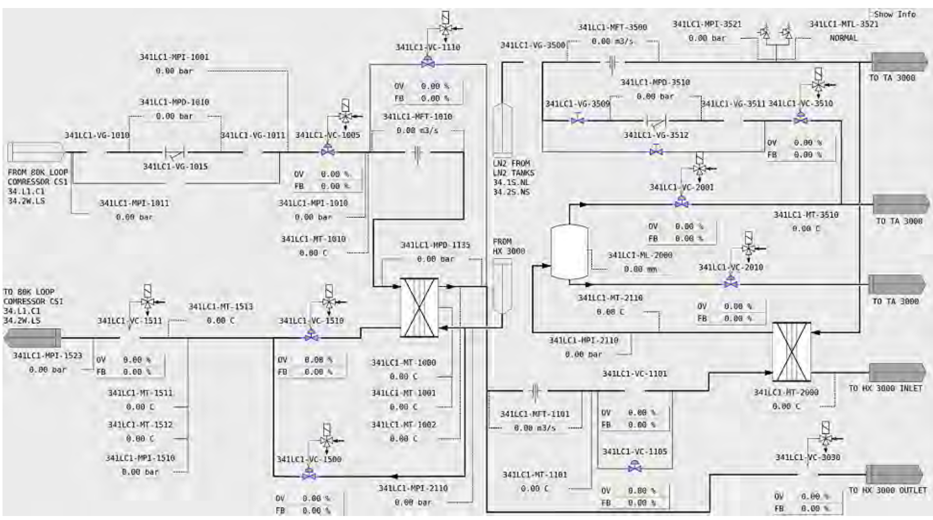
Instrumentation and Control (I&C) is part of the scope of supply for the majority of the in-kind contributions of the EU to ITER.

The F4E I&C Group has provided technical support and coordination services to all relevant Procurement Arrangements, during both the preparation and the implementation phases. According to the strategy and maturity of each system, this included requirements management and formalisation, participation and organisation of design reviews, review of design documents from plant system suppliers and selection processes.

The activities have been performed by F4E I&C team by providing direct support and by making use of two framework contracts:

- 7 ppy of efforts have been provided as part of the Direct Support. The breakdown between systems and management is presented in the figure below;
- 5 ppy of efforts were provided through the I&C Support contract, awarded to INDRA, which main scope is to provide F4E, with engineering effort in the I&C, System and Electronic 10 ppy of efforts were provided through the System Integrator contract, awarded to GTD Systems. The main scope is to design, prototype and/or implement I&C systems.

Among the 2015 achievement it is worth mentioning the programming and Integration of the CA2 Alarm Survey System; the advanced Conceptual and Preliminary Design of the Magnetics Diagnostics Plant System Controller hardware and software; the development Plan and Phase 1 of the GENROBOT project; the design and implementation of the integration of buildings equipment into the ITER CODAC central system; Preliminary design of the I&C system for the HCLL PbLi loop;the design of the integration of European cryoplant into ITER CODAC central systems;



Prototype of 80K loop user interface

Metrology

Factory Acceptance Tests as well as intermediate process geometry assessment are key steps in the development of components that have to be delivered to ITER. In particular, the check of mechanical interfaces between adjacent components is very important to allow a smooth assembly process of the ITER machine. In this framework, the Metrology Team provides transversal support to all F4E Project Teams in the field of metrology, geometrical survey and procedure development.

During 2015, the work has been focused on ITER first priority projects. Vacuum vessel Toroidal Field (TF) and Poloidal Field (PF) coils projects have absorbed the largest part of the Metrology Team's resources.

A vacuum vessel shielding block inspection

A flexible housing CMM inspection

Drawing Office

During 2015, the F4E Drawing Office (DO) kept deploying the ITER collaborative design infrastructure. There are now more than 20 European companies connected to this infrastructure. About 100 designers are working from their premises on the CAD data managed in the ITER IO ENOVIA database located in Cadarache, France.

In 2015, 48 designers were trained and certified by F4E DO professionals on specific ITER CAD methodologies. 22 new designers were trained and certified in the usage of the See System Design, the ITER software tool for authoring PFD and P&ID diagrams.

One of the key activities performed by the F4E DO is related to the management of all the CAD data exchanged between the ITER IO Central Team, F4E and F4E suppliers. The exchange of CAD data is performed according to a formal ITER Design Exchange Transfer (DET) procedure. Almost 400 DETs were managed in 2015.

Plasma Engineering

A part of F4E's Plasma Engineering (PE) activities are carried out in support of EU procurements. Another part is carried out on the basis of ITER Task Agreements (ITAs) which are awarded as the result of competition between Domestic Agencies or on the basis of specific competence.

In 2015, a large part of the activity consisted in the follow-up of existing grants and contracts.

In the field of PE, F4E awarded two contracts in 2015: one for the simulation of plasma response to magnetic perturbations generated by a combination of FI, TBMs and EFC, and the second one for the computation of 3D eddy and halo currents on plasma-facing components.

The implementation of the above grants and contracts involves several European fusion laboratories (Aalto University (Finland), CEA (France), ENEA (Italy), CCFE (United Kingdom), CNR (Italy), KIT (Germany), Austrian Association, SPC (Switzerland) and IPP (Germany)).

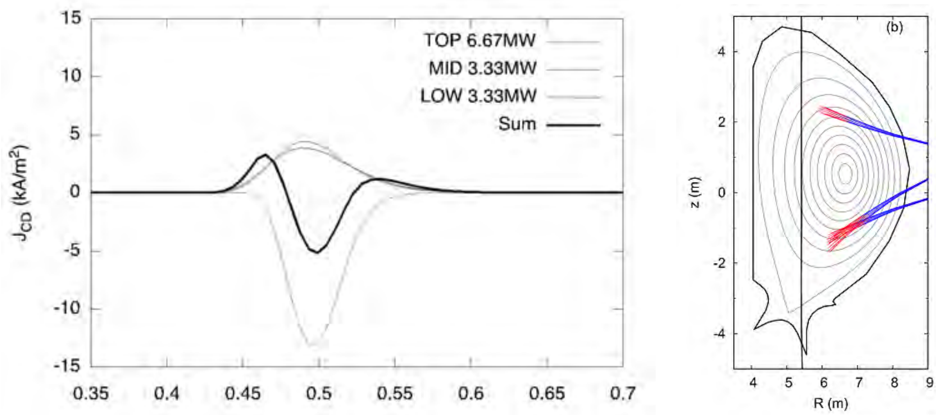
The contracts and grants in place cover the following main topics: plasma control; ITER scenarios development including breakdown; assessment of loads on plasma-facing components; assessment of disruption loads and disruption mitigation techniques.

Progress Report

A comprehensive study was carried out with Aalto University to assess the fast ion confinement for a wide set of ITER scenarios representing operation from commissioning to full performance The simulations, carried out with the ASCOT suite of codes, take into account all relevant 3D effects such as ferritic inserts, TBMs and ELM control coils. The plasma response to external perturbations was also included, as computed by the MARS-F code in the frame of a parallel F4E contract with CCFE.

The evolution ITER plasmas fuelled with gas and/or pellet injection has been investigated for the first time self-consistently with the integrated core+SOL transport suite of codes JINTRAC (CCFE, CREATE, Wien University). The results demonstrate that understanding how to optimise fuelling performance is essential to operate ITER and to achieve high fusion performance. The simulations show that α heating is essential to access ELMy H-mode conditions. Pellets may be essential for the density evolution to obtain an L-mode density above the NB shine-through limit. Density minimisation during the L-H and H-L transition is found to be critical.

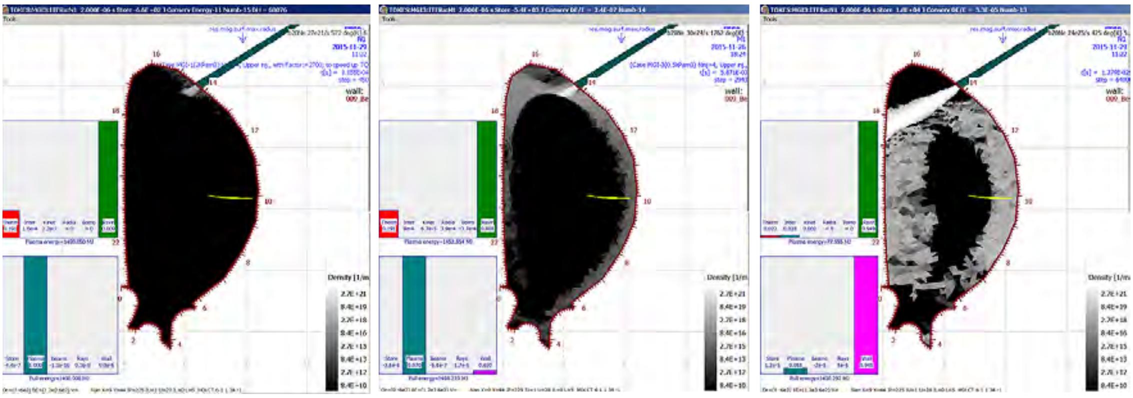
The beam-tracing code GRAY was integrated in the simulation suite JINTRAC, under a contract with CNR, Milano. The inclusion of the beam tracing code is aimed at the simulation of Electron Cyclotron (EC) heated tokamak plasma scenarios with an integrated approach, in which the heat and current sources provided to the plasma by EC are taken into account during the determination of the plasma state used for the computation of the sources themselves.



OPE 541: Simulation of scenarios with power split over different functions (heating, ST control, NTM stabilisation)

An activity was also started with KIT for the simulation of energy loads onto plasma-facing components in ITER during disruptions and run-away events, when mitigation by massive gas injection (MGI) or shattered pellet injection (SPI) is applied.

Other activities in the area of Plasma Engineering in 2015 included support to the EU members of the ITER Science and Technology Advisory Committee (STAC) and to the Technical Advisory Panel of F4E.

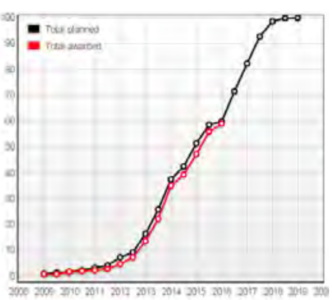


OPE 584: Example of MGI computation: density in three cases with different number of injectors and Ne pressure

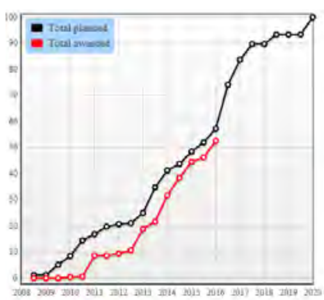
Broader Approach

The table below shows the key performance indicators for the three Broader Approach (BA) projects, based on deliverables considered by the projects as having been made during the period, and comparing the accumulated credit awarded versus which was planned.

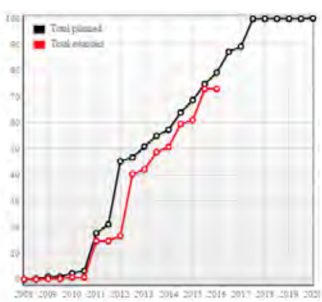
	JT-60SA (STP)	IFMIF/EVEDA	IFERC	BA
End December 2014 Earned/planned credit	88.2%	85.9%	97.7%	91.5%
End December 2015 Earned/planned credit	97.6%	86.3%	99.4%	95.4%



JT-60SA (STP)



IFMIF/EVEDA



IFERC

Status of earned value (European plus Japanese percentage of total committed credit awarded) for the three BA projects at the start of the indicated year

For the BA projects as a whole ~90% of the activities are carried out by voluntary contributors, and only ~10% directly by F4E. The following report therefore focusses on the progress of all of this European work, not just that funded directly by F4E.

Satellite Tokamak Programme

In 2015 a large number of important targets has been achieved in the Satellite Tokamak Programme, thanks to the dedication of the JT-60SA team bringing together, in an enthusiastic spirit of collaboration, F4E and a number of European Institutions (CEA (France), CIEMAT (Spain) CNR-RFX (Italy), ENEA (Italy), KIT (Germany), and SCK CEN (Belgium)). The fabrication of the Toroidal Field (TF) coils progressed at accelerated pace culminating with the delivery of the first complete TF coil to the Cold Test Facility (which was ready and commissioned to start the tests immediately). The Quench Protection Circuit installation and commissioning in Japan was successfully completed (exactly on schedule). The installation of the cryogenic system was completed at the Naka site in Japan and its commissioning was started. The full set of TF coil High Temperature Current Leads was tested and delivered to the Japan Atomic Energy Agency (JAEA). Work on the other magnet power supplies, current leads, and cryostat vessel body is also proceeding well.

On their part, our Japanese partners at JAEA proceeded with the fabrication of their share of components achieving, most notably amongst many, the challenging result of the completion of the installation of 340 degrees of the vacuum vessel.

2015 is going to be remembered as a remarkable year in the history of JT-60SA project in general and in particular for the EU contribution.

Toroidal Field Coils

The full set of cables necessary for the fabrication of the 18 coils was produced by ICAS and – after testing – delivered to the TF coil manufacturers, namely ALSTOM (now General Electric - GE) and ASG, which are under contract since 2011 to CEA and ENEA respectively.

ASG, which completed the manufacturing phases up to impregnation for all the winding packs of coil 1 to 9 by September, received the first stainless steel casing in June and proceeded with the insertion of their first Winding Pack (WP). By the end of September 2015 the welding of the casing covers had been completed. The impregnation of the coil no. 1 has been completed in November and the coil was sent to the subcontractor in charge of the final machining in December 2015.

GE took delivery of the components of the first casing over the period from March to May 2015 and proceeded with the insertion of their first Winding Pack. Thereafter the inner and outer legs of the casing were welded together around the winding pack manually, and the casing covers were welded using twin semi-automatic welding robots. The Winding Pack was embedded in the casing in August, The coil was successfully resin impregnated and sent for the final machining of the external mechanical interfaces in September. The final machining of the mechanical interfaces on the coil casing with respect to the Winding Pack centreline was completed by the end of October. After the installation of the piping and instrumentation, geometric survey and other Factory Acceptance Tests (e.g. pressure test, leak test and insulation test under Paschen

Final machining of coil no. 10 (November 2015) (Courtesy ALSTOM/CEA).

Coil 1 – welding of casing after coil insertion (September 2015) (Courtesy ASG/ENEA).

conditions) the coil was delivered to the Cold Test Facility in Saclay, France, on 17th December. In the meantime GE received 2 further casings (i.e. three in total), completed seven winding packs out of nine which they must supply (excluding spares) and performed the insertion of the coil no. 11 in its casing and its impregnation.

The contract for the TF coil casing manufacture was placed by ENEA with Walter Tosto (WTO) in 2012.

In 2015, after solving a number of technical issues related primarily to the respect of geometrical tolerances during final machining, the manufacturing process has been brought under control and, as of the end of December 2015, Walter Tosto has delivered seven complete TF coil casings to the coil manufacturers (four at ASG and three at GE).

The contract for the manufacture of the Outer Intercoil Structures (OISs) was placed by CEA with SDMS, France, in March 2014. The 18 OISs are welded structures of large dimensions: 7 metres long, 1.8 metres wide, with a weight of 5 tons, to be manufactured with sub-millimetre accuracy. They are designed to withstand intense forces exerted on the TF coils and are linked together by insulating bolted junctions. Welding of the first OIS was completed at the end of June 2015 and its delivery to Saclay, France, after machining was completed in November 2015. Electron beam welding is underway for subsequent OISs, the manufacture of which began once the critical processes had been successfully established by the first OIS.

In parallel, the design of the fasteners for the splice plates was qualified. The contract for the gravity supports (GS, an inverted V-shaped strut pair) was awarded by CEA to ALSYOM, France, in April 2014. The first gravity support was completed in December 2015.

The design of the challenging Inner Intercoil Structures (IIS), which have the primary responsibility to resist large electromagnetic loads of the TF coils, has been agreed. The testing to demonstrate that the components could be disassembled, if necessary, was completed. Calls for tender relative to the fabrication of fasteners and pins for the OIS and IIS were launched at the end of 2015. The components will be delivered to JAEA shortly after the delivery of the first two TF coils.

F4E, with the support of ENEA and CEA, has also launched the fabrication of two spare coils as a risk mitigation measure.

Cold Test Facility: CEA Saclay completed the installation and, in September 2015, the commissioning of the TF coils cold test facility was carried out. During a first commissioning test with a superconducting single turn shunt at the nominal current (25.7 kA), the power supply, electrical circuits and instrumentation were validated. After this test the superconducting prototype coil of the W7-X project was integrated in the cryostat. This coil was cooled down and tested several times to validate also the cryogenic loops and the cold circulation pump. The Magnet Safety System (MSS) which measures and evaluates the quench detection signals has been developed by CEA and was also tested successfully. The facility was modified slightly to increase the cooldown capacity of the refrigerator.

High Temperature Current Leads: The 26 high temperature superconducting current leads (HTS CLs) which connect the superconducting feeders with the power supply busses are provided by KIT.

The dedicated cold test facility (CuLTKa) was fully operational. By adding a second test cryostat four current leads can now be cooled down simultaneously and tested in sequence. This shortens the testing period.

The works acceptance tests of TF01 to TF06 were successfully passed. All 6 TF current leads were shipped to the Naka site in Japan. Manufacturing and testing of four current leads for the CS&EF coils (PF01 to PF04) was finished without problems. During these tests also the transient behaviour during plasma operation with variable currents followed by a dwell period was studied. The next four current leads PF05 to PF08 are in the final assembly stage. They will be integrated in the test facility and tested in spring 2016. The remaining HTS current leads PF09 to PF20 are in different stages of manufacturing.

Magnet Power Supply Systems

Quench Protection Circuit (QPC): The on-site installation of QPC components, started in December 2014, was completed by Nidec ASI (Consorzio RFX CNR-RFX, Italy) on 18th February 2015, followed by the related commissioning activities, including the voltage to ground test, the pressure tests of the cooling water circuit and the functional tests on all QPC units. QPC activation sequences were successfully performed on all QPC units, and completed on 12th June 2015. The completion of the procurement activities, corresponding to the closure of QPC PA was achieved on schedule, on the 31st July 2015. The transfer of ownership of the QPC from CNR-RFX to F4E and from F4E to JAEA has been formalised.

Switching Network Units (SNUs): The SNUs are being procured by Energy Technology - OCEM for ENEA.

Following the successful completion of the type tests on the first Central Solenoid SNU, the manufacture the components of the three remaining SNUs was completed in the summer 2015. The routine tests on the By-Pass Switches and on the Discharge Resistors were successfully performed in July 2015. The routine tests on the complete SNU system were successfully performed in November 2015. For these tests the four SNUs were completely installed in the supplier premises with a layout similar to the final one and connected to the Local Control Cubicle. All required functional tests were performed on each SNU, and the complete operation was successfully tested also with reduced current interruption with nominal voltage.

Superconducting Magnets Power Supplies (SCMPS): The procurement of the superconducting magnet power supplies (SCMPS) is shared by CEA and ENEA, by means of two separate contracts, placed in 2013, with JEMA Energy SA and POSEICO-JEMA respectively. The SCMPS Design Report, was approved on 10th July 2015,

CEA activities: The manufacture of EF3 and EF4 PS was completed in June 2015, allowing performing the factory tests in the EF3 PS in July 2015. Successively, also the manufacturing of EF2 and EF5 PS was completed and the related factory routine tests were performed in November 2015. Generally the performed tests proved the correct design of converters. In addition, the seismic tests on one PS crowbar was positively performed as type tests (activity shared with ENEA procurement) in May 2015, proving the correct seismic design of this safety relevant equipment.

ENEA activities: The major part of the factory tests on FPPCC PS have been successfully performed in March 2015, proving the good performance of the system (converters and transformers) at nominal current and voltage. The remaining tests at maximum current on the FPPCC crowbar are planned in March 2016. The manufacture of CS2 and CS3 transformers was completed in September 2015. The related factory tests (including short circuit test and thermal tests, not required in the technical specification) were successfully performed in October 2015. The manufacture of CS2 and CS3 converters started in the second half of 2015, and is planned to be completed in the first months of 2016.

Resistive Wall Mode Power Supplies

The Procurement Arrangement for the Resistive Wall Mode Power Supplies (RWM PS), backed by the related Agreement of Collaboration between F4E and CNR acting through Consorzio RFX, was signed on 21st April 2015. After the finalisation of the technical specification for the procurement, the related Call for tender was issued by Consorzio RFX in November 2015. The actual start of contractual activities is foreseen in the first months of 2016.

Cryostat

The European contribution to the procurement of the cryostat for JT-60SA consists of the cryostat base and the cryostat vessel body, both provided through CIEMAT. Japan has contributed the material for the cryostat vessel body. The cryostat base was delivered to Japan in January 2013.

The vessel body is being manufactured by ASTURFEITO S.A. (AF). The design for all the Cryostat Cylindrical Body sections was completed in March 2015. The manufacturing of the three components of sectors 2-3 and their metrology have been completed. The result of the final metrology on sector 2-3 shows very good results on planarity and good results at the interface flanges. The manufacturing of the components of sector 4-5 at the end of 2015 was at ~75% completion while welding of the ports is in progress. All other sectors are in various stages of the manufacturing process.

Cryogenic System

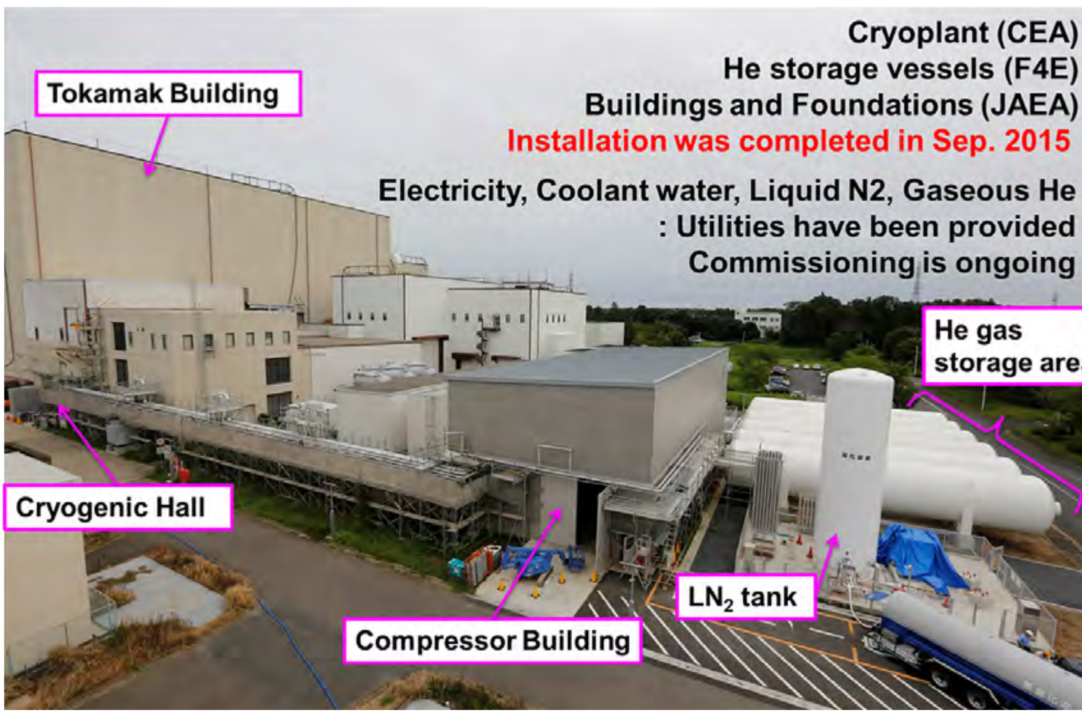
The superconducting coils, thermal shields, HTSCLs and divertor cryopumps, which require refrigeration at different temperatures ranging from 3.7 K to 50 K provided by a cryoplant with an equivalent refrigeration capacity of about 8 kW at 4.5 K, have been procured through a CEA contract with Air Liquide Advanced Technology (AL-AT) signed in 2012.

All components of AL-AT part of the supply (fabricated mostly in France and Germany) were collectively shipped from Antwerp harbour, Belgium, to Japan in the middle of January 2015. The delivery arrived at Hitachi port

(Japan) end of March and was transported by JAEA from the port of entry to the Naka site. Unloading and positioning was performed jointly by JAEA and AL-AT.

The six large gaseous helium storage vessels (74 tons, 250 m^3 each), required to collect and store the helium gas inventory, were provided by F4E through its contractor A. Silva Matos, Metalomecânica S.A., Portugal. The vessels arrived in May 2015 at the Japanese port of entry of Hitachi. Thanks to a careful coordination and successful logistics, they were all installed without any difficulty or delay.

From April to September all subsystems and interconnected pipework were installed and pressure and leak tested to avoid any ingress of air impurities. At the beginning of October 2015, AL-AT started the pre-commissioning of the different subsystems. All helium circuits were purged and filled with pure helium. Compressors, oil removal system and pumps were functionally tested step-by-step. During a 48-hours 'capacity test' the combined operation of all eight large screw compressors (2.4 MW electrical power) at maximum flow and discharge pressure was demonstrated. By early 2016 the cryogenic machines (turbines, cold circulator, and cold compressor) will be installed with the aim to start cooldown of the refrigeration coldbox by March and reach acceptance in summer 2016.



Aerial View of the JT-60SA cryoplant at the JT-60SA site (in Naka, Japan).

IFMIF/EVEDA Programme

Integrated Project Team

In 2015, the Integrated Project Team of the IFMIF/EVEDA PT at Rokkasho (Japan), JAEA and F4E submitted at request of the Broader Approach Steering committee (BA SC), a resource-loaded schedule for the accomplishment of the Accelerator facility for an extension until December 2019. The BA SC meeting held in December approved this extension; no additional funds are required respecting the total amount of credits assigned to BA projects. Accordingly, an update to the project plan was approved with key milestones related to the four major phases of the accelerator installation and commissioning was identified.

Further progress in key aspects of IFMIF/EVEDA project management was achieved with respect to the Procurement Arrangements (PAs):

- All PAs are signed;
- With the exception of one PA (LIFUS 6 erosion/corrosion testing) for Engineering Design Activities, and for Lithium Target validation and for Test Facilities validation are successfully completed (i.e. 19 PAs out of 20 PAs);
- Progress in Accelerator Facility validation is coherent with PAs and their amendments. A first set of PAs (Buildings, Ion source, Diagnostics) is already completed.

Further management activities were shared and accomplished jointly with the Project Team of the IFMIF/EVEDA project and JAEA were:

- Installation of a F4E on-site representative covering Health and Safety consultancy (contract awarded to Bureau Veritas Japan);
- Definition of roles and responsibilities (OBS) for the LIPAc installation and commissioning;
- Consolidation and execution of the Earned Value Management (EVM) system to track and report the progress of the project.

Main Technical Achievements

Test Facilities

The HFTM design validation process was concluded with manufacturing and testing to a 1:1 length scale prototype with two compartments (six rigs). This prototype was studied in Karlsruhe in the HELOKA-LP helium loop at 1:1 cooling conditions (simulating nuclear heating by additional electric heaters) over the full range of temperatures and heating powers. For this purpose, manufacturing tests were performed for all parts necessary to build the HFTM. Adequate performance over the full range of operation conditions, concerning pressure, mass flow rates, (surrogate) nuclear heating and capsule temperatures 250-550°C was demonstrated.

For monitoring the neutron flux at high neutron fluxes, Cerenkov Fibre Optics Sensors (C_FOS) were developed and studied under BR2 reactor conditions in order to enable a constant on-line assessment of the irradiation conditions inside the modules. An arrangement of C_FOS in U-shaped bundles was giving satisfactory results when irradiated to a dose around 10 GGy. Based on these results, it is expected that they will work in the IFMIF environment. It is therefore recommended to further develop this option in the detailed design phase of the STUMM module.

As the final stage in the validation of the fission chambers for their use of neutron flux monitors for the typical irradiation periods in IFMIF, two detectors were acquired and tested in the BR2 reactor. The key objective was to test their robustness under a combined neutron/gamma field. Over the testing period available in BR2 which corresponds to about 3-4 weeks in IFMIF at full power, it was found that the results achieved were satisfactory.

Lithium Target

After the completion of Lifus 6 plant commissioning test achieved during the first months of 2015 and the positive implementation of solutions/optimisations to face all the encountered problems, it was possible to conclude the starting purification of lithium flowing inside the plant. This permitted to dispose of lithium characterised by a nitrogen concentration ≤ 30 wppm, satisfying requirements defined in the procurement arrangement. At the end of the purification phase, eight specimens (four for each of the two investigated materials) were inserted inside the test section of the plant, then the first experimental test started in November, aimed at investigating the erosion-corrosion resistance of the specimens exposed to flowing lithium for 1 000 hours. The correct value and the stability of the many operative parameters of the plant (temperatures, flow rates, pressures etc.) were checked and successfully verified during the test time. This short term test was successfully completed at the beginning of January 2016 showing very good safeguarding of N purity.

Accelerator Facility: Linear IFMIF Prototype Accelerator (LIPAc)

The main technical and scientific highlights of the LIPAc in 2015 are as follows:

- The commissioning of the injector progressed steadily after it was resumed in April 2015. Initially the optimisation of the operation parameters were performed with a proton beam for which currents over 100 mA and emissivity parameters satisfying specified targets were obtained. Starting in October 2015, Deuteron Beam Commissioning progressed successfully with regard to the optimisation of the emittance at beam currents over 100 mA and over. At low duty cycle, the target values for the emittance (<0.3 π•mm•mrad) were observed. The local control system of the injector was integrated into the central control system and was proven under beam operation. The first two modules of the Radio Frequency (RF) power sources, including its HV Power Supply, for the RF Quadrupole (RFQ) were delivered in Rokkasho and have been set up in the accelerator building;

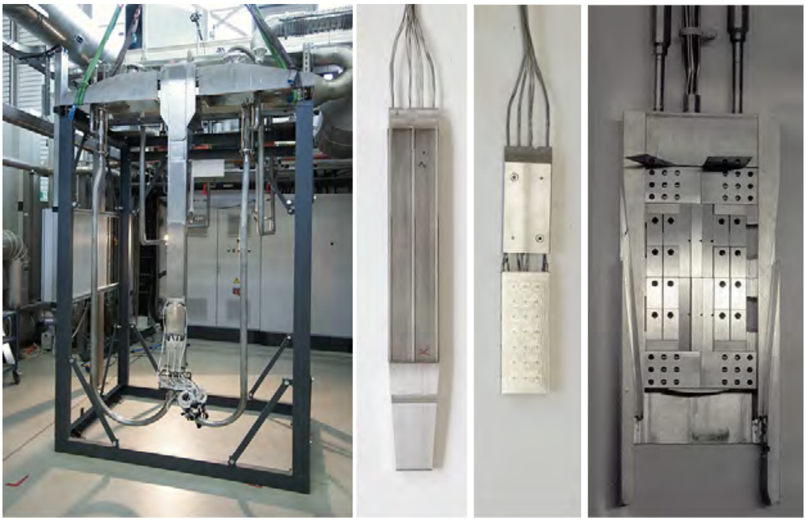
- The high power part of the RF Quadrupole (RFQ) passed successfully its acceptance test at INFN Legnaro. The fabrication of the 18 modules for the RF Quadrupole for LIPAc was completed. Their assembly into the three super-modules was started for an expected arrival to Rokkasho by February 2016;

- The design of the SRF Linac progressed well. The application form of the cryomodule was forwarded to JAEA for review. The individual parts of the pre-series cavity were manufactured during June and October 2015, followed by the RF factory tuning. For the series cavities, all the fabrication steps, which were possible to carry out before the welding NbTi flanges and the Nb tubes, were completed by November 2015. With regards the SaTHoRi Test Bench, a blank assembly with the cavity and coupler mock-ups was successfully performed and the cryostat was delivered at CEA Saclay on October 2015. The acceptance test of the magnetic shield after the heat treatment was successfully conducted at CEA Saclay in December 2015;

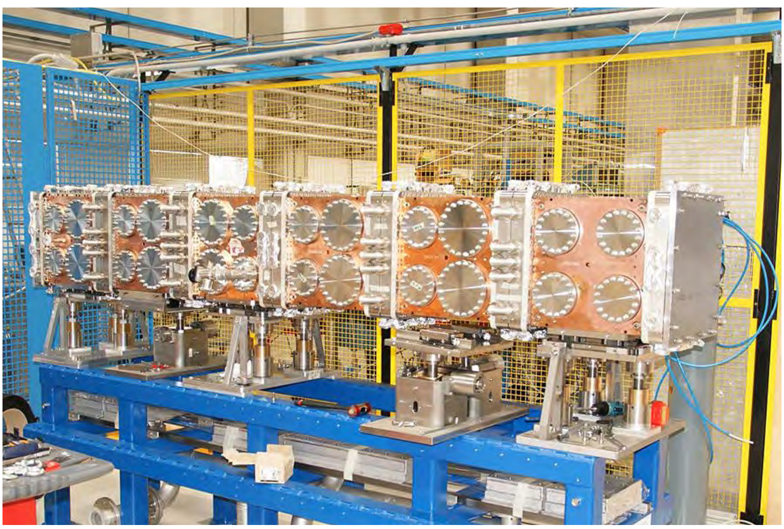
- With regards to the MEBT, along 2015 all the acceptance tests for the beamline were successfully conducted. By the end of the year, all the beamline components were aligned and all the main components integrated in the line. The magnets' cooling skid was shipped to Rokkasho, whereas the design and fabrication of the buncher cooling skid is ongoing. The MEBT will be shipped to Rokkasho in early 2016;

- Final engineering work was devoted to the design of the last subassembly of the HEBT line. The cooling skid for both HEBT and MEBT magnets was shipped to Rokkasho on December 2015. The quadrupoles design was finished and approved. The coils and yokes are being manufactured. The contract for the procurement of the dipole magnet was signed in December 2015;

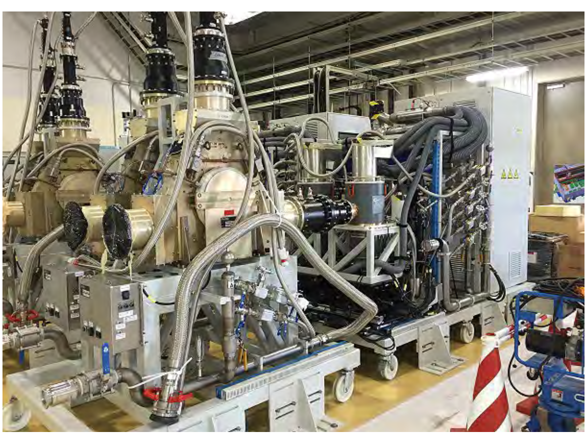
- After the approval of JAEA concerning the detailed licensing framework for the Cryogenic Production Unit contract, procurements were launched and manufacturing is almost complete. The Cold Box is awaiting assembly and Factory Acceptance Tests will be conducted in January, at the Air Liquide Advanced Technologies (AL-AT) factory. Licensing documents including design drawings, manufacturing and test certificates, were submitted by mid-December 2015.



Fabricated prototype items: Left: The HFTM double compartment prototype during installation in HELOKA-LP; Middle: a completed rig and a capsule with upper reflector; Right: The specimen stack in a so-called assembly tray before insertion into the capsule



One of three super-modules forming the RF Quadrupole accelerating unit before its shipment to Rokkasho



Two RF power modules (out of the four to be supplied) for feeding the RF Quadrupole installed in the RF hall of the LIPAc building at Rokkasho

IFERC Programme

In 2015, the IFERC project:

- Continued the successful operation of the Computational Simulation Centre (CSC), with one upgrade to the system;
- Continued the activities in DEMO R&D in materials and DEMO Design, increasing the interaction between the two areas;
- Continued the implementation of the ITER Remote Experimentation Centre (REC) activities.

Computational Simulation Centre

In 2015, Helios (the supercomputer provided by CEA under a contract with Bull) entered its fourth year of exploitation, and completed its fourth cycle of computational projects. Bull continued to fulfil its contractual commitments for availability and performance of the system. The last important upgrade to Helios was decided in October 2015, when the configuration of the last extension to Helios, based on Nvidia GPGPU was agreed. The extension will be installed in January 2016. The purpose of this partition is to provide the fusion community access to a different architecture to prepare efficient and skilful usage of the most "state of the art" supercomputer system. In addition, in December 2015, the main practical conditions for the end of operation and the dismantling of the CSC were agreed.

Typically during the year the usage of Helios was between 85 and 95%, and the availability of the machine remained above 98%.

The Helios supercomputer is provided free of charge to the EU and Japanese fusion modelling communities. Various surveys of the users have been performed and the level of satisfaction is rated very high.

DEMO Materials R&D Programme

DEMO activities continued in 2015 as planned in the Procurement Arrangements (PAs).

DDA PA: In 2015, the results obtained in the joint DEMO Design Activities (DDA) have been summarised in an Annual Report. In Europe, most of the contribution to the DDA activities comes from of work executed in the EUROfusion Consortium by a geographically distributed project team involving many EU laboratories, universities, and industries. The results of the design and R&D work conducted in Europe in 2015, as part of the EUROfusion PPPT Programme, are described in the Annual Report, with emphasis on activities of design and physics integration that are part of the work package WPPMI - Plant Level System Engineering, Design Integration and Physics Integration that includes many common elements with the work conducted in Japan.

In addition to the EUROfusion activities, in 2015 a part of the work has been contributed by F4E; with gaps analysis of Eurofer97 steel with respect to its appendix material A3.19AS of the nuclear code RCC-MRx. This work has been performed within F4E's Test Blanket Module and Material Development Project Team.

JET dust PA: The joint analysis of T-contaminated dust from the JET divertor and JET tiles continued. The dust and tiles were delivered to Rokkasho in 2014, and the analysis techniques and characterisation have mainly taken place in 2015.

Remote Experimentation Centre

In the initial IFERC project plan, the Remote Experimentation Centre (REC) should have been demonstrated by proving remote experimentation from Rokkasho of the JT-60SA machine. In view of the delay of the start-up of JT-60SA, the scope and schedule of REC were re-examined in 2012 by a joint group of the two Implementing Agencies and EU experts. The group recommended that every effort should be made to optimise the usage of resources and to benefit the CSC and JT-60SA projects, and to explore the possibility of demonstrating REC in an existing experimental facility in operation.

Following the definition of the requirements of the REC in 2013, in 2015 the implementation of the software development for the remote experiment system (RES) and the experimental data analysis software (EDAS) in JT-60SA has continued, with a contract placed by F4E and others in preparation. The needs for data storage have been defined and a plan to reuse decommissioned CSC hardware agreed. The EU contribution includes a cash contribution for the hardware of the REC control room (made as planned in 2015) and the development of software for remote participation and data access.

Contracts and Procurement

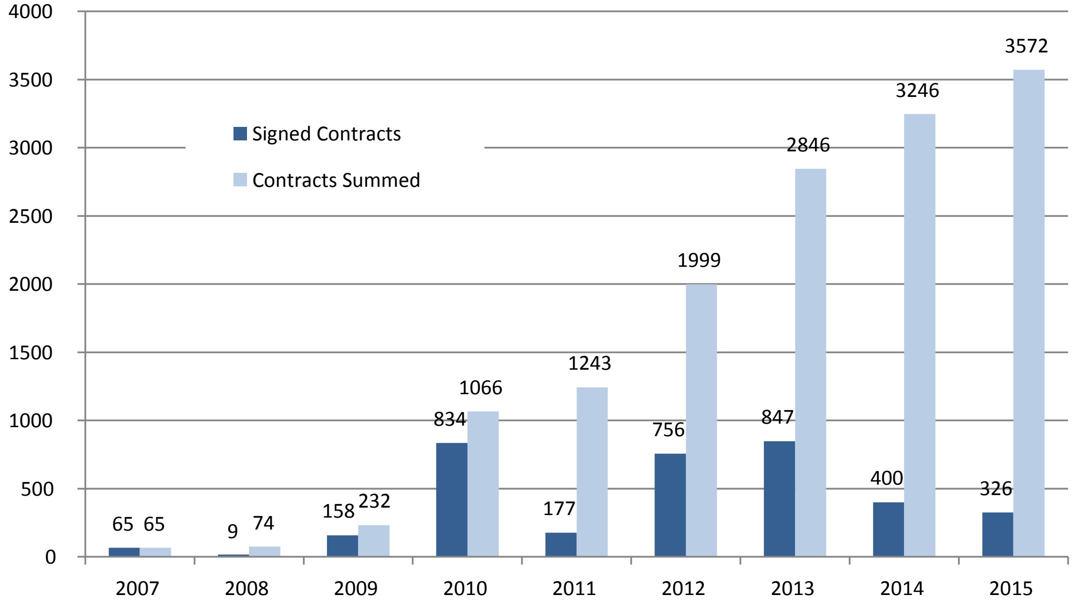
As anticipated, the ITER project tendering activities are moving to a new phase, with a large number of lower value contracts. This follows the foreseen evolution of the ITER project. At the same time F4E has increased the engagement in the contract implementation activities as a consequence of the progressive shift in its efforts: the volume of contracts under implementation has increased during 2015 to a new record number. Substantial resources to address a large number of cross-service issues and to support the development of organisational systems and long-term capabilities have been deployed.

- Among these, of particular relevance were: The continuous support to the development of internal processes, procedures and manuals;

- The follow-up of important action plans in response to external and internal audits;

- The strengthening of the knowledge management efforts, including the identification and preparation of comprehensive guidelines and best practices, including further improvements to key processes such as Evaluation and Amendments. In addition, an important contribution was provided to the development of the new Financial Regulations and their Implementing Rules;

- The reinforcement of reporting capacity, in terms of accurateness and detail. In this sense, the management and follow-up of procurement procedures increasingly moved to the new IT tool, the Procurement Platform. This system is integrated with the rest of the data management systems in F4E at the central F4E Integrated Reporting System, allowing to homogenise the data usage, to standardise the drafting of procurement documents and to increase the reporting efficiency and the analysis capacity;

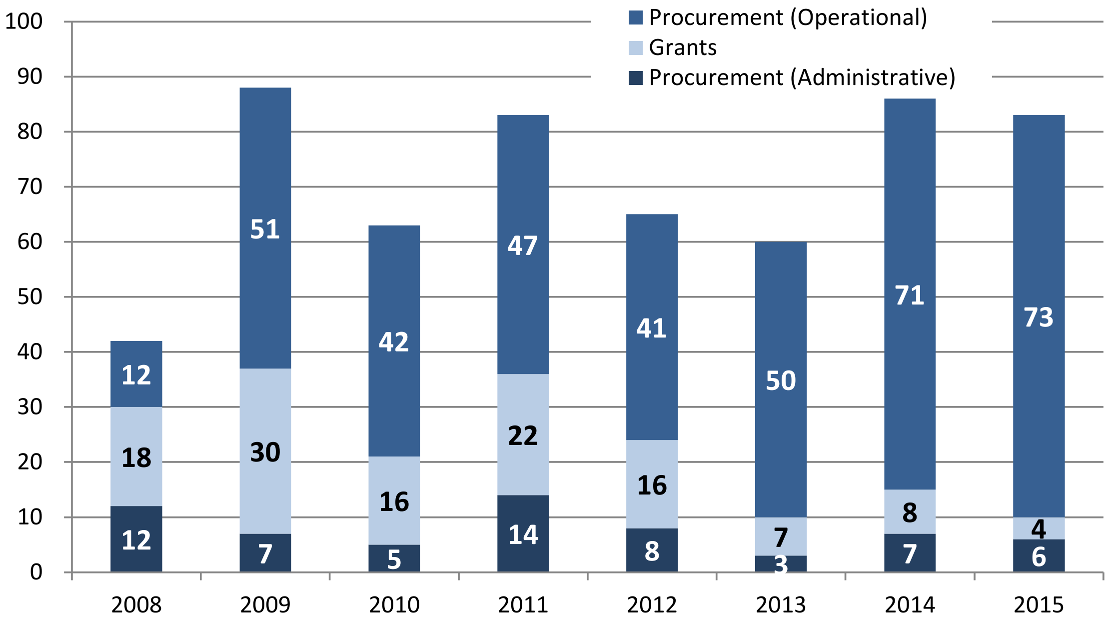


Annual and cumulative value of contracts and grants signed by F4E

- The increase of data analysis support to a number of internal and external stakeholders as the European Commission's General Directorate for Research and Innovation, the European Commission's General Directorate for Energy or the Internal Audit Service. In parallel, reporting internally to the Unit is being developed to support the monitoring and management of the unit activities;

- In 2015 a new Cost and Financial Analysis function was deployed within the Contracts and Procurement Unit (CPU) in support of centralised efforts to implement detailed cost management system. This function comprises activities such as follow-up of annual indexation for contracts, support to Evaluation Committees with respect to the evaluation of financial selection criteria and when needed detailed financial evaluation of companies and support to related transversal tasks;

- The focus on supply chain identification and management, in view of addressing sustainability and long term development of the European fusion industrial capacity.



Procurement and grant procedures launched (number – excluding Task Orders)

Procurement and Grants

During 2015, a total of 73 operational procurement procedures were launched and 79 procurement contracts were signed for a value of about EUR 326 million. Major operational procurements were awarded and signed in the area of Buildings and Remote Handling, but significant procurements were also signed in relation to Magnets and Neutral Beam.

In particular in 2015, F4E signed the framework contract for the Neutral Beam Remote Handling System (RHS) under nuclear environment, completing the Remote Handling main contractual strategy. This contract will cover the whole cycle for the Neutral Beam RHS, from the design to the installation and Final Acceptance Tests.

Also relevant is the signature of the contract for Site Infrastructure Works, as it will ensure the complete conditioning of the ITER site, hence allowing the construction of all the remaining buildings and facilities.

In the area of Magnets, F4E has signed the contract for the provision of the manufacturing and cold test activities in the Poloidal Field (PF) Coil Building on the ITER site in Cadarache, where the fabrication of the Poloidal Field coils PF2-5 and the PF6 Cold-testing will take place.

As regards to transversal areas, in the area of Technical Support Services, six framework contracts were signed to cater for the needs of the different Project Teams of the ITER Department over a period of four years:

- Two multiple framework contracts for the provision of thermo-hydraulic and fluid dynamics analyses;

- A multiple framework contract aiming at providing material characterisation at cryogenic temperatures;
- Three multiple framework contracts covering the areas of seismic analyses and design of building and mechanical components, dynamic analyses of building and mechanical components, and structural analyses and design of building and mechanical components of the ITER facility.

Further to this, to support the Nuclear Safety and Quality Unit, a contract of similar nature was signed to provide Quality Assurance (QA)/Quality Control (QC) follow-up services, implying to deploy resident, itinerant and spot surveillance inspectors to monitor the work of F4E vacuum vessel suppliers and subcontractors over the next four years.

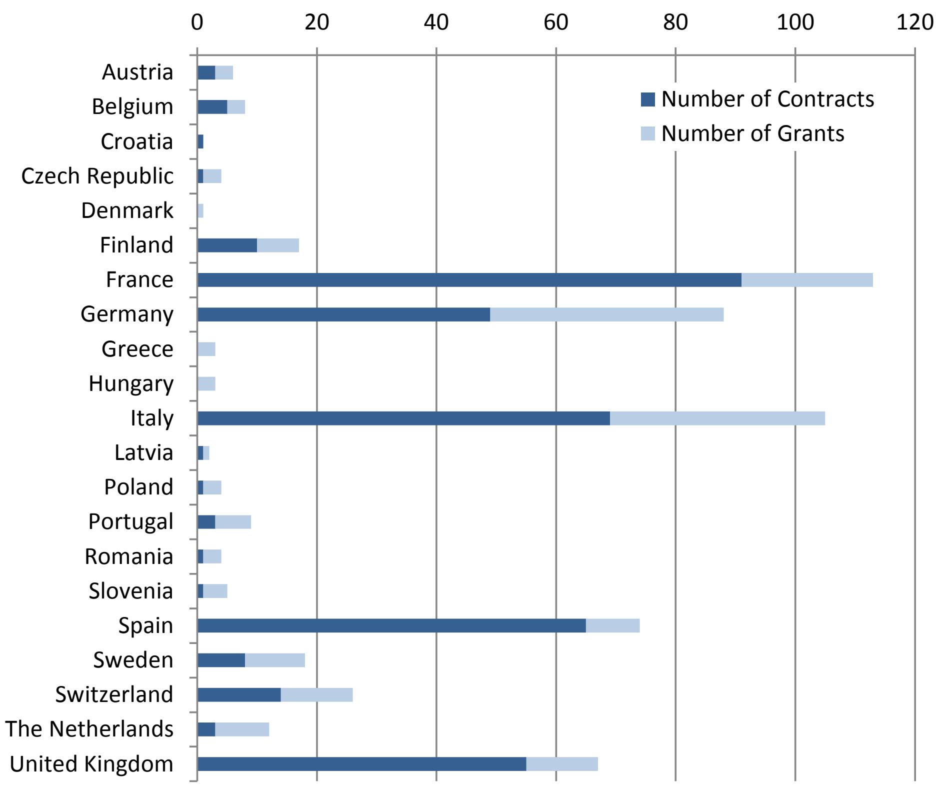
Many of the systems and components belonging to the EU in-kind obligation continue to move out of the R&D phase and into the design and prototype manufacturing phases of their lifecycle, therefore being contracted by means of procurements. Nevertheless, in spite of the slightly reduced number, implementation of grants for R&D activities continues to have a high strategic role for Europe's capability to deliver the full contribution to the ITER and Broader Approach projects and to positively exploit their scientific and technological results. During 2015, a total of four grant procedures were launched and nine grant agreements were signed. This corresponds to a grant budget of about EUR 6 million.

The most significant grant during 2015 was the Framework Partnership Agreement that was signed with two European research institutions for the material characterisation, code qualification and design rules of EUROFER97 steel.

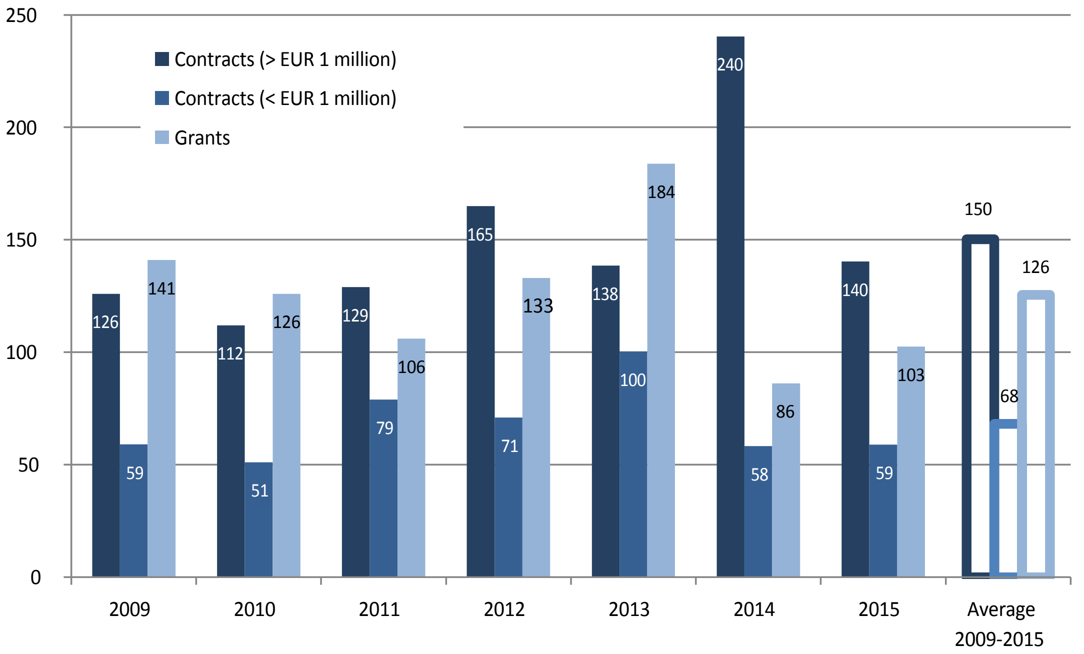
During 2015, a total of five administrative procurement procedures were launched and 150 procurement contracts (direct, framework and specific) were signed, with a budget of EUR 6.15 million. Within these, three service framework contracts for the provision of medical services to F4E.

The average time to contract for procurements above 1 million euro decreased significantly during 2015 with respect to year 2014, aligning with F4E average in the period 2009-2015 for this range of procedures. At the same time the average time to contract for procurements below 1 million euro and grants remained in line with 2014 figures.

Contracts with external experts allow swiftly answering to any technical need that may arise within the different F4E departments and projects. In the frame of the last Call for expression of interest launched, in 2015, 39 expert contracts were signed serving ten project teams within three departments of F4E.

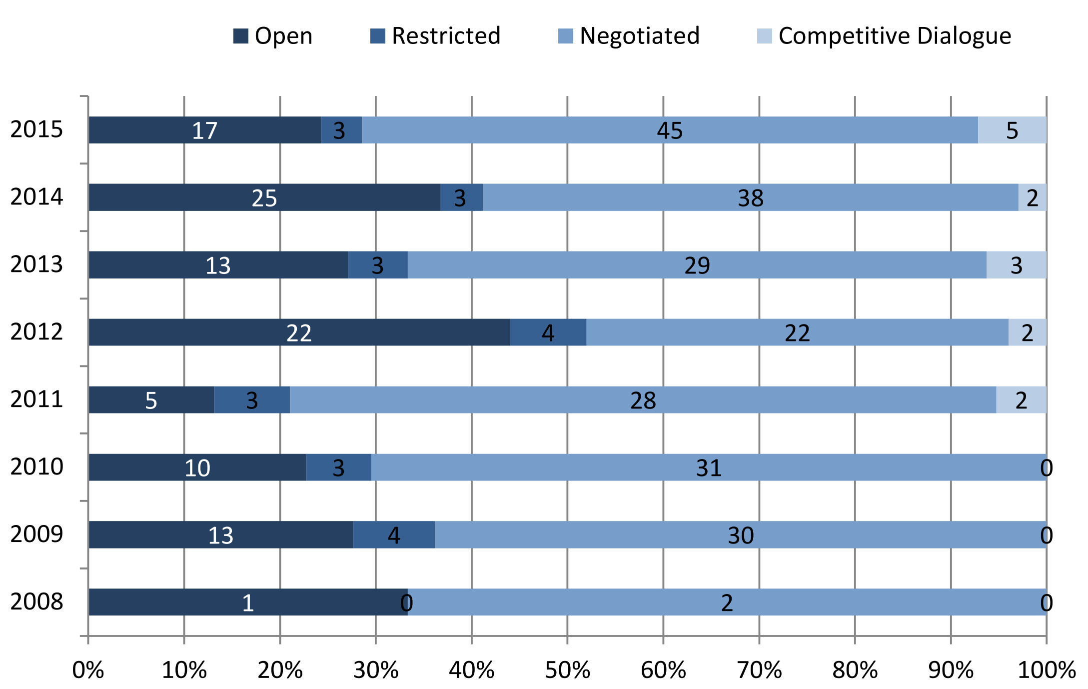


Geographical distribution of awarded contracts and grants (Number in the period 2008-2015)

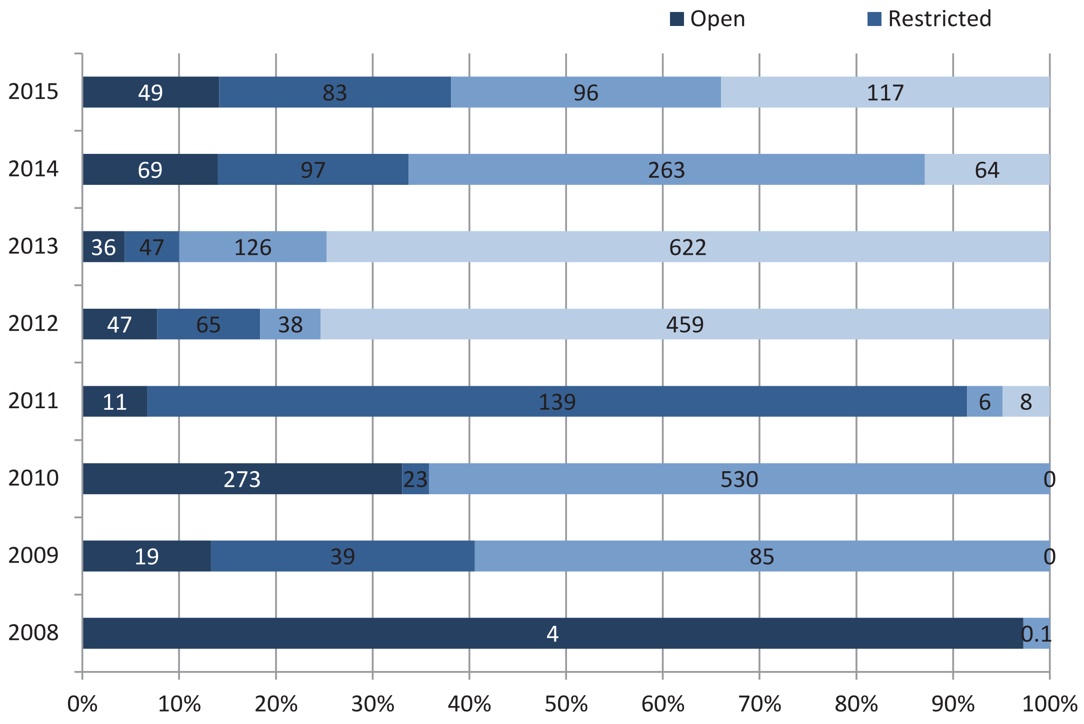


Average time to award contracts and grants (days from submission to deadline to award)

Summary by Type of Procedure



Contracts awarded by procurement procedure (Number)



Contracts awarded by procurement procedure (EUR million)

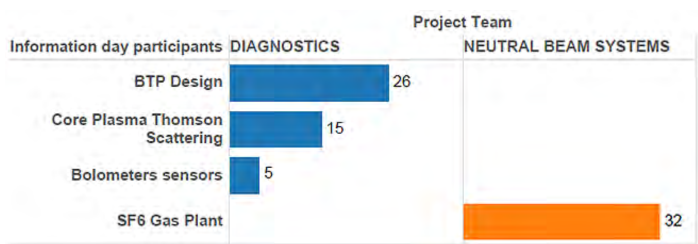
Market Intelligence and Intellectual Property

With regards to Market Intelligence-related activities, during 2015 F4E has continued to develop its pre-procurement activities and tools and to enrich its interactions with European industry and European Fusion Laboratories EFLs) in view of enhancing the efficiency of its procurement actions.

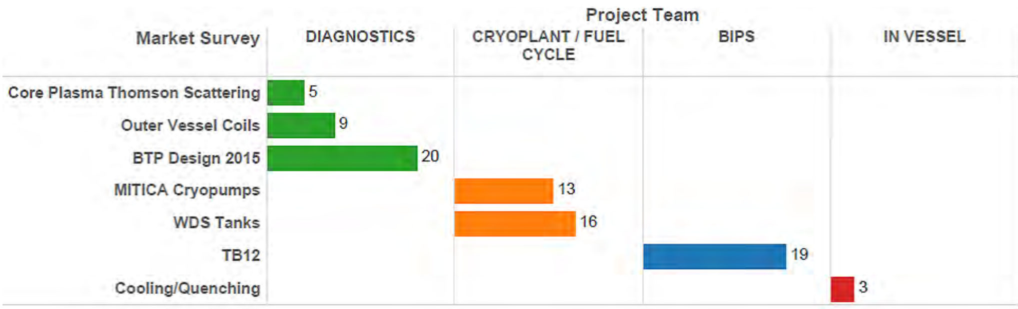
Through the F4E Industry Portal and the Industry Liaison Officers (ILO) network, F4E has various channels of communications with European industry.

Industry outreach activities during 2015 included:

- During 2015, F4E has entered into the data-gathering phase of the project in relation to Contractor Assessment and Supply Chain and Industry Mapping that aims to run in 2016;
- Four ILO meetings took place. These meetings have supported wide dissemination of information on past, on-going and future procurement activities and related needs for the fulfilment of the European contribution to ITER;
- F4E organised four Information Days in relation to specific procurement actions. F4E representatives also attended many meetings, seminars and conferences organised in the EU Member States, mainly as part of the preparation of procurement activities in various technical areas;
- For more precise identification of capabilities, seven market surveys have been published through the F4E Industry Portal, involving the participation of almost 80 companies. Most of the market surveys launched in 2015 have been targeted to support the development of procurement strategies.



Information Days organised by F4E in 2015

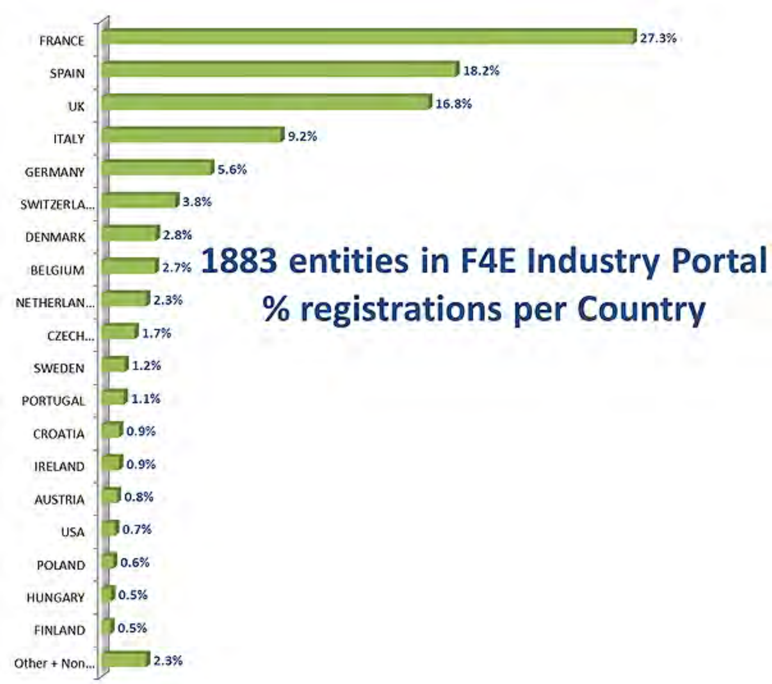


Market surveys organised by F4E in 2015

With regards to the activities of the group in relation to Intellectual Property, during 2015 the new process for the management of Intellectual Property within the procurement procedures and within contracts has been widely implemented. An effort has been made to facilitate the management of IP, especially by SMEs. This has been carried out by populating F4E's website with guidelines and information.

In addition, new IP provisions were produced for those contracts of low relevance from the point of view on Intellectual Property and there have been discussions at the level of ITER IO to harmonise the management of contracts for the purchase of off-the-shelf products.

From the point of view of Technology Transfer (TT), F4E has enhanced its presence in international fora and has initiated a series of contacts with other bodies (e.g. Joint Research Centre, European Space Agency) to achieve synergies. F4E has kept working to guarantee the successful transfer of technology among our contractors.



Market surveys organised by F4E in 2015

Budgetary and Financial Management

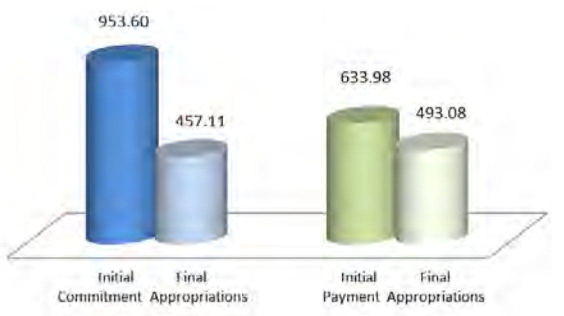
The 2015 financial statements and the budget implementation are detailed in the 2015 Annual Accounts[1] and in the 2015 Budgetary and Financial Management Report, which are published separately.

Establishment of the Budget

F4E's 2015 budget was initially adopted by F4E's Governing Board for the amount of EUR 953.60 million in commitment appropriations and EUR 645.10 million in payment appropriations, even though the Euratom contribution in payment decreased by EUR 11.11 million in the last steps of the EU budgetary procedure. The definitive original budget in payment appropriations was therefore EUR 633.98 million.

The budget was successively amended in the Governing Board meeting held in June and the Governing Board meeting held in December.

The final budget for 2015 is EUR 457.11 million in commitment appropriations and EUR 493.08 million in payment appropriations.



F4E's 2015 budget (M€)

Contributions to the Budget in Revenue

The actual revenue is payment appropriations, amounting to EUR 493.08 million in the final 2015 budget. The repartition of the 2015 revenue ensures a fair balance between contributors, in line with their relative share for the overall period of ITER construction.

Implementation of the available 2015 budget

[1] *The F4E Annual Accounts can be accessed on: http://fusionforenergy.europa.eu/aboutfusion/keydocs.aspx*

Implementation of the Budget in Revenue

The final statement of revenue is almost entirely cashed, including outstanding revenue from the previous year.

Only small amounts are still due for the membership contribution of Spain and an on-going recovery of a pre-financing following the anticipated termination of a contract, for a total amount of less than EUR 0.05 million.

Implementation of the Budget in Commitment Appropriations

The entire available budget is implemented in commitment appropriations, including the appropriations carried over from the previous year.

There are no specific observations regarding the implementation of the administrative budget for which the permanent monitoring of the needs through hearings and arbitration cycles allows reaching a fair balance between actual needs and budget.

Regarding the operational expenditure 100% of the budget is implemented, of which 52% through direct individual commitment only.

The lower performance in individual commitment than originally foreseen (100%) is mainly due to:

- Decrease in the amount of cash contribution requested by ITER IO;
- Decrease in the amount of cash contribution requested by Japan due to the delay of the signature of their Procurement Arrangements (i.e. Atmospheric Detritiation System) where EU contribution is foreseen;
- Postponements of contracts in areas such as Remote Handling, Diagnostics and Plasma Engineering.

The implementation of the budget is balanced with global commitments in accordance with the last amendment to the 2015 Work Programme, for on-going procurements to be finalised in 2016. The main domains involved are:

- Buildings, for amendments or options on the main buildings contracts;
- Vacuum Vessel, for the completion of the procurement of the main vessel.

Notes:

- Except for current expenditure of administrative nature, all F4E contracts are multiannual, with an average duration estimated of about three years;
- One commitment for an amendment to the SPIDER contract is financed from the Reserve Fund.

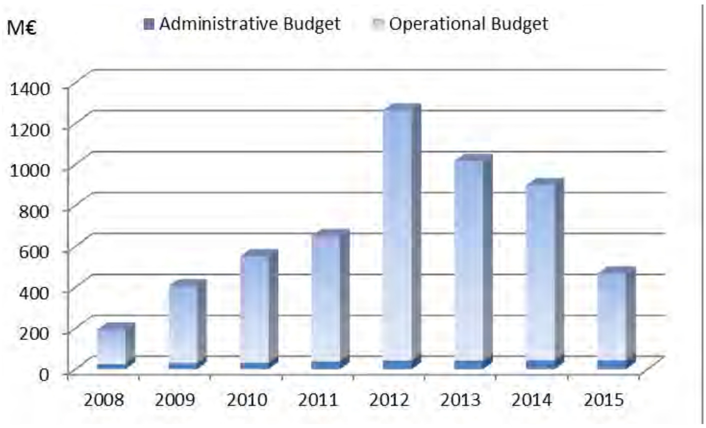
Implementation of the Budget in Payment Appropriations

The implementation rate of the 2015 final available budget is 98% in payment appropriations:

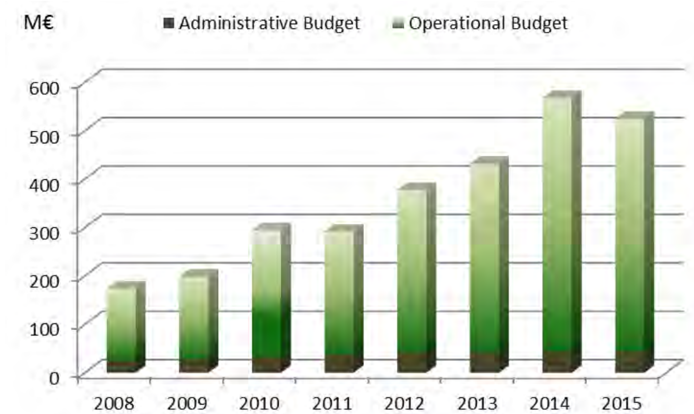
- 87% of implementation of the administrative expenditure, slightly lower than the performance of the previous year. The balance available is almost entirely carried over to the 2016 budget according to the rules on Non-Dissociated Appropriations, for the actions launched during 2015 but not yet paid at the end of the year;
- 80% of the administrative expenditure automatically carried over from the previous year.
- 100% of the total operational expenditure, including the appropriations automatically carried over from the previous year.

The 2015 Budget and the Previous Budgets

The following graphs show the evolution of the available F4E budgets in commitment and payment appropriations since F4E financial autonomy in 2008.



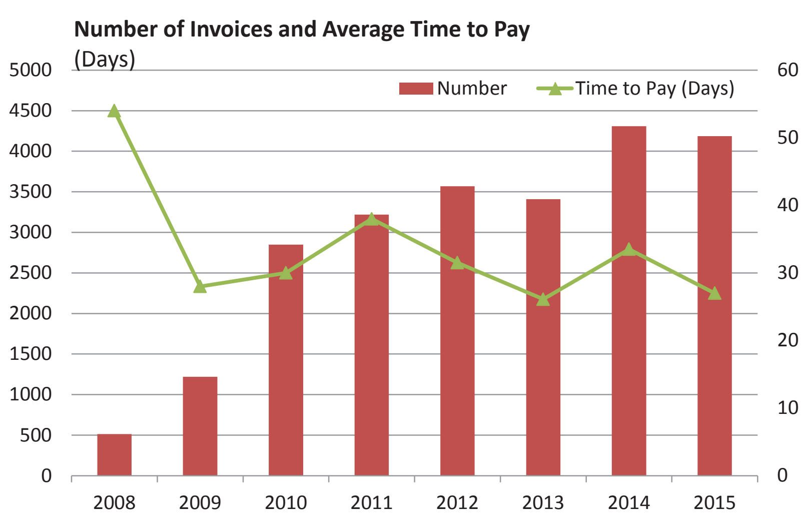
F4E available budgets in payment appropriations (EUR million) since 2008



F4E available budgets in payment appropriations (EUR million) since 2008

Finance

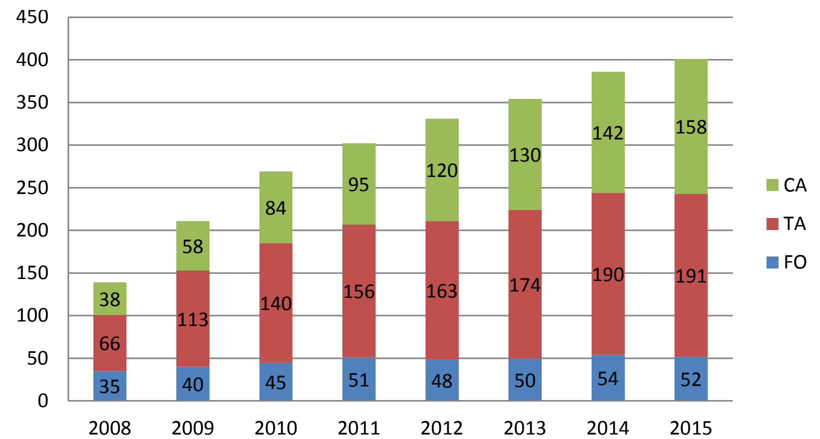
During 2015 F4E has processed 4 200 payment transactions (excluding salaries) and revealing a slight decrease of 3% in comparison with 2014. Out of these, 1 500 payments corresponded to settlements of invoices, for which the average time to pay invoices has decreased by ~7 days, as a result of the efforts made in optimising the associated financial processes. The implementation of the electronic workflow for payments in the previous year has shown a significant efficiency increase. F4E paid 38.46 EUR of late interest in 2015.



Human Resources

Personnel Selection and Recruitment

As of 31st December 2015, the total number of occupied posts at F4E was 252 EU Officials and Temporary Agents[2] (out of 262 authorised), and 167 Contract Agents[3] (out of 180 authorised). In addition, F4E counted on the support of 15.8 interim staff (in FTE[4]) and two letters were sent to Seconded National Experts (SNE) who are scheduled to start in 2016.



Evolution of the staff from 2008 to 2015 where FO stands for EU Officials, TA for Temporary Agents and CA for Contract Agents

During 2015, 25 vacancy notices were published: ten Temporary Agents and 15 Contract Agents. Overall, 26 selection procedures were completed: 19 from the positions published in 2015 and 7 selections from the positions published in 2014. A total of 12 Temporary Agents and 23 Contract Agents took up duties as per the following table (distributed by type of contract, category and department):

Following the Call for expression of interest addressed to candidates who had already passed a selection procedure (CAST) managed by the European Personnel Selection Office (EPSO) which F4E launched in 2011

Department	FO	TA	CA
Office of the Director		3 AD	1 IV
ITER		3 AD	5 IV, 3 III, 2 II
Project Management Infrastructure & Control			2 IV
Broader Fusion Development		3 AD	
Administration		3 AD	5 IV, 4 III, 1 II

[2]Of which 52 EU Officials and 191 Temporary Agents in place and 9 sent (and accepted) Temporary Agent offer letters.
[3]Of which 158 in place and 9 sent (and accepted) offer letters.
[4]Full Time Equivalent

in order to better target the selection procedures for support, four CAST procedures were launched out of which four candidates were recruited.

The average amount of time invested in a selection procedure in 2015 was four and a half months. This period starts with the publication of the vacancy notice and ends when the final reserve list is established.

Personnel Policy

F4E adopted the Implementing Rules (IR) of the Staff Regulations concerning the appraisal of Temporary Agents and Officials; the appraisal of Contract Agents; unpaid leave and leave on personal grounds; the use and engagement of Temporary Agents recruited under Article 2f of the Conditions of Employment of Other Servants (CEOS).

The Agency also adopted revised policies in the area of internal mobility, language training and internships.

Furthermore, F4E rolled-out its first 360° assessment exercise. The exercise was limited to managerial staff allowing them to obtain insight into their strengths and development areas. F4E also launched a skills database, giving staff members the opportunity to declare their skills and/or interest for working in other organisational units than their own. The initiative complements the launch of a revised internal mobility policy which was introduced during the summer.

Traineeship schemes

In April 2015, a new training scheme was launched. The objective was to promote training in the fusion field and in the ITER project as well as to allow university graduates to provide contributions to the work carried out by F4E.

The traineeships will last a minimum of four months and a maximum of nine months with one annual intake in October of each year.

In October 2015, nine new trainees (eight in Barcelona and one in Garching) took up duties at F4E. Four were assigned to the ITER Department, three to the Administration Department, one to the Broader Fusion Development Department and one to the Communication and Stakeholder Relations Unit (reporting to the Director).

Training

The table below summarises the training activities for the year and correlates these to 2014.

Type/number of trainings:	2014	2015
At the European Commission (SLA)	71	33
Collective training organised at F4E	70	60
External training courses + conferences and seminars	165	154
Staff attending language courses at F4E	170	149
Average number of training days per staff member	6.7	6.1

Working Conditions/Social Policy

Some of the main achievements during 2015 related to this sector include:

- 2015 F4E procedure for taxi reimbursement in case of health reasons (for staff unable to render themselves to work for health related reasons);

- Conclusion of three new framework contracts for the provision of medical services: the first for the provision of a medical centre ("Creu Blanca"); the second for the provision of medical advice services and the third for the provision of Medical Controller services. The first two medical suppliers remained the same as previous years. The third one will be provided by a new company, TEBEX SA, specialised in the management of labour incapacity;

- Since the signature of the three framework contracts, the Medical Service in Fusion for Energy has enlarged its services and it is currently offering new services such as health risk advice, psychological advice;

- In August 2015, an agreement was finally concluded between the Joint Sickness Insurance Scheme (JSIS) and CatSalut (the Catalan public health scheme), and from December 2015 F4E staff members who requested an affiliation received sanitary cover by CatSalut;

- During 2015, the F4E Medical Service performed 24 pre-recruitments: 134 annual check-ups and 16 health screening programmes were discussed with the Medical Advisor. As part of the general health consultancy, 394 visits were carried out, out of which 205 were medical visits, 117 were medical consultations, 27 were ergonomics consultations, 29 were administrative consultations and 16 were Health Screening Programmes;

- As in previous years, health campaigns targeting all staff members were developed based on the results obtained through annual check-ups. Thus, health campaigns were tailor-made and always in the interest of staff. In the "Flu Vaccine" campaign, 31 staff members were vaccinated at the F4E premises, whereas the "Healthy Heart" campaign saw 104 staff members having their blood pressure measured and benefitting from the advice of the Medical Advisor following their results;

- Due to the expiration of the framework contract with Sanitas (which has been F4E's complementary health insurance provider for the past four years), F4E launched a new Call for tender in July 2015 for the provision of a sanitary insurance coverage and a new framework contract was signed at the end of December 2015 for another four years with the same company and with better conditions;

- International schools: 158 children were enrolled in 19 international schools, covering different EU languages, for the academic year 2015-2016;

- Relocation: 17 newcomers in Barcelona and three in Cadarache were provided with relocation service support.

Staffing Statistics

This section provides statistics on the gender and nationality of F4E staff.

Staff	EU Official		TA		CA	SNE	Total
	AD	AST	AD	AST			
Female	11	9	32	10	88		**150**
Male	26	6	134	15	70		**251**
Total	**37**	**15**	**166**	**25**	**158**	**0**	**401**

Gender distribution for all staff in place (%)

Staff	EU Official		TA		CA	SNE	Total
	AD	AST	AD	AST			
Belgian	1	1	6	5	8		**21**
British	1		14	2	4		**21**
Bulgarian			1		3		**4**
Czech			2		2		**4**
Dutch			4		1		**5**
Estonian					2		**2**
Finnish			4				**4**
French	5	4	43	5	15		**72**
German	3		5	1	9		**18**
Greek	1	1	3		4		**9**
Hungarian	2		1	1	2		**6**
Irish			1	1			**2**
Italian	13	4	34	3	31		**85**
Lithuanian		1		1	3		**5**
Maltese	1						**1**
Peruvian					1		**1**
Polish			1		1		**2**
Portuguese		1	4		4		**9**
Romanian			4	1	4		**9**
Slovak	1						**1**
Spanish	8	3	37	5	64		**117**
Swedish	1		2				**3**
Total	**37**	**15**	**166**	**25**	**158**	**0**	**401**

Breakdown of staff in place by nationality (%)

Job Screening Exercise

The Framework Financial Regulation (FFR) establishes the obligation for the Agencies to carry out a benchmarking exercise with the aim of being able to justify administrative expenditure in a more structured way.

Following the methodology proposed for 2016 by the Interagency Network in line with Article 29 of the FFR, F4E is providing annexed the detailed results of its Job Screening exercise.

This exercise stems from and strives to improve on the European Commission's Screening methodology. It categorises the Joint Undertaking's human resources according to which organisational role each job is serving. As its main focus, this exercise generates figures on:

- Administrative Support and Coordination;
- Operational; and
- Neutral

jobs in all organisational entities. These results shall be compared against the results of future years, and in a long term perspective they could also be compared to those of other EU agencies/Joint Undertakings or even to the European Commission.

The categorisation of all jobs will be undertaken in terms of Job Screening categories, similar to the ones used by the European Commission, with a specific interest in identifying the jobs evolution in each of the roles with an endeavour to increase the proportion of jobs dedicated to the operational activities (if, or when, possible).

The results of this year's exercise are detailed in the Annex section of this publication. Although they cannot be compared to other years given that this is the first time that it takes place at F4E, we can see that the percentage of overheads is relatively low (just under 17%). This is due in part to the type of mandate of F4E, and in part to the matrix organisational structure in place which closely integrates operational, neutral and administrative resources.

Legal and Control Environment

Legal Matters

During 2015, F4E managed a wide range of legal matters, notably:

- Solving legal issues arising in the preparation of F4E procurement procedures, negotiations and contract drafting;

- Elaborating solutions to legal issues facilitating satisfactory settlements under ongoing contracts;

- Negotiating and drafting agreements with ITER IO and amendments thereto;

- Successful management of litigation (e.g. the General Court of the EU dismissed an application by European Dynamics in full and ordered the applicant to pay the costs (T-553/13); successful defence of F4E position in interim measures proceedings before the Civil Service Tribunal of the EU);

- Elaboration of a new Financial Regulation and Implementing Rules and successful negotiation of derogations from the EU standard rules so as to reflect F4E operational needs (This lead to the adoption of the new Financial Regulation and Implementing Rules by the F4E Governing Board on 2nd December 2015 and their entry into force on 1st January 2016 (with the exception of notably the titles on procurement and grants which enter into force on 1st June 2016);

- Revision of four model contracts (for direct supply, direct service, framework services and low value respectively);

- Launch of a Call for tender for the provision of mediation services to ensure the implementation of a full mediation process;

- Review of F4E export control procedures and setting up of an F4E internal compliance programme to ensure full compliance with the applicable regulations;

- Addressing legal issues arising from internal and external audits;

- Managing legal aspects of internal processes, procedures, manuals and guidelines (e.g. contract modification guidelines, grant cost reimbursement guidelines, the policy on abnormally low value tenders, approach to contractor's claims under F4E operational contracts).

Fraud Prevention

In June, F4E adopted its 'Anti-Fraud Strategy' and its Action Plan 2015-2017 (AFS), requested for all EU bodies. The AFS is a comprehensive document which explains the context in which F4E operates, i.e. being responsible for managing a high amount of public budget, and the prevention and detection of respective fraud mechanisms. Particular objectives were set, like e.g. nominating an Ethics and OLAF Officer and raising awareness.

Later in 2015 and implementing an action of the AFS, the F4E Director adopted rules concerning the disclosure in the public interest ("Whistleblowing Rules"). These rules enable whistle-blowers to fulfil their duty to speak up if they become aware of a "serious irregularity" (i.e. an illegal activity, including fraud, corruption or other serious professional misconduct or wrongdoing at F4E), thus serving the public interest, by fostering integrity, transparency, accountability and legitimacy in and of F4E.

In 2015, the GB also adopted the revision of the 2013 conflict of interest rules applicable to F4E bodies and committees. This completes the rules managing conflicts of interest regarding F4E staff, adopted by the GB in 2014.

In the reporting period, no case of fraud has been detected.

Data Protection

Regarding data protection, F4E continued to implement the requirements of Regulation (EC) 45/2001 concerning the protection of individuals with regard to the processing of personal data by the Community institutions and bodies. The main objective is to guarantee the lawfulness of the processing of personal data, its security and confidentiality as well as to provide data subjects (i.e. F4E staff, Committee members as well as external experts) with the possibility to exercise their rights regarding the treatment of their personal data.

For 2015 the following is to be emphasised:

- Constant progress has been made in evaluating the personal data compliance within F4E, together and between the internal DP coordinators and the DPO, as well as, where prior checking is required, with involvement of the European Data Protection Supervisor (EDPS). Advising on data processing and privacy notices related e.g. to health, administrative inquiries, traineeship, industrial portal, conflicts of interest rules, and 360° feedback exercise.

- Notifications validating the processing of personal data were adopted and updated, for example on video surveillance, interims, internal mobility, access control, sick leave.

- The F4E Register of all adopted and modified notifications has been completed and is now being available to all staff in a transparent way on the intranet, F4ENET.

- Horizontal issues were at stake with the EDPS: e.g. the monitoring survey 2015. F4E also answered (successfully) to an individual complaint addressed to the EDPS.

- The DPOs of all EU institutions and bodies meet regularly in order to exchange experience, streamline processes and discuss important issues with the EDPS (e.g. EU data protection reform).

Overall Control and Monitoring Strategy

In 2012, the F4E Governing Board adopted F4E's 'Overall Control and Monitoring Strategy' which contributes to the "assurance chain". The main objective of this strategy is to provide reasonable assurance to the F4E Director and external stakeholders on the state of internal control in F4E. It also sets out the framework to ensure that operational and financial transactions are implemented to the highest standards expected for such a project as ITER and to allow a close monitoring of the overall internal control system in place.

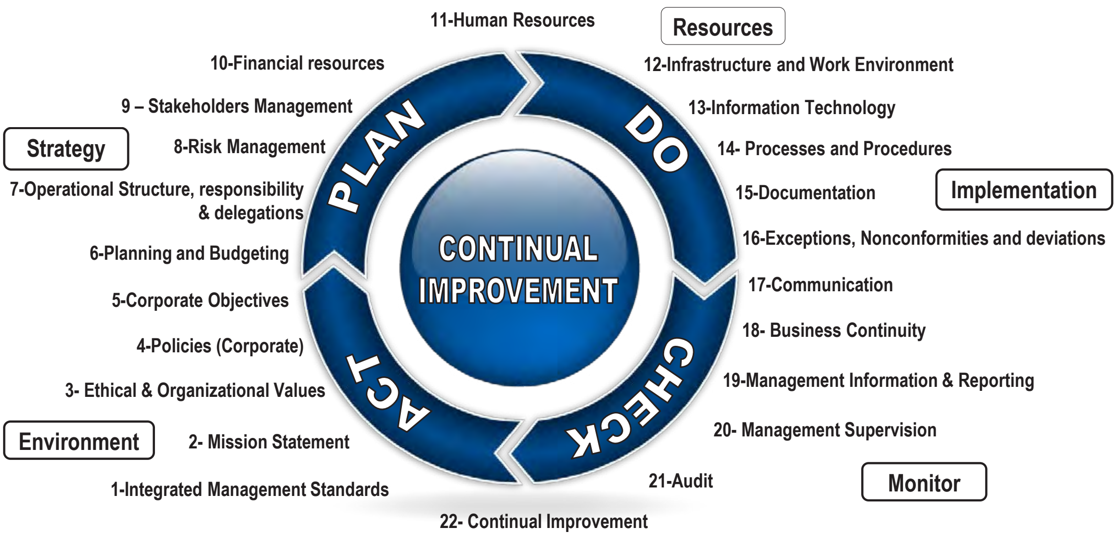
Integrated Management System (IMS) and Standards

The F4E's Integrated Management System (IMS) combines the two control environments within which F4E operates:

- The ITER-wide Quality System which is intended to ensure the performance of ITER and the compliance with the nuclear safety requirements;

- The European Commission Internal Control Standards (ICS) which are inspired by the internationally recognised COSO framework.

The Integrated Management System Standards (IMSS) are the backbone of the Integrated Management System. The IMSS are a set of standards specifically developed by F4E, integrating the ISO-9001 quality requirements, the ICS and the ITER Project quality and safety requirements.



The control objectives of this system are:

1. Sound financial management of operations (effectiveness, efficiency and economy);
2. Safeguarding of assets and information;
3. Reliability of reporting;
4. Compliance with applicable law and regulations, in particular:

a. Quality aspects and nuclear and safety requirements;

b. Legality and regularity of budget implementation;

c. Prevention, detection, correction and follow-up of fraud and irregularities.

In its third Annual Assessment of F4E for 2014, "the assessors recognise the value of the IMS and consider it a complex, robust system for an efficient and effective management and recommend its systematic implementation".

F4E is currently in the process of reviewing the IMSS, in order to account for the revision performed by the European Commission of its ICS and the latest update of the ISO-9001 in 2015.

At the same time, the IMSS will be streamlined and simplified, in order to enhance the effectiveness of the Integrated Management System and its implementation. A preliminary draft was presented and discussed into the Audit Committee in February 2016 and it is expected to be adopted in June 2016 by the Governing Board.

Control Environment

The main elements of the F4E control environment have been further strengthened in 2015 and adapted to respond to audit recommendations and the evolving needs of the organisation. The F4E control environment is composed of different assurance elements:

- The Assurance Strategy on Grants and Procurement contracts;
- The Corporate Internal Supervision Function;
- The Quality Management System;
- Audit results from the Internal Audit Service (IAS), the Internal Audit Capability (IAC) and the External Audit (European Court of Auditors);
- The Risk Management;
- The annual external assessment of F4E.

In addition to these assurance functions, each staff member who has received a (sub) delegation for the implementation of F4E's 2015 budget was requested to provide their personal "Declaration of Assurance" for the budgetary area for which they were responsible. In 2015 the decentralisation followed the organisational structure, with a clear segregation between administrative (financial) and operational (project) management, empowering staff members within their areas of responsibility. In total, 39 declarations were received for 2015. These declarations together with the reports from the different assurance functions form the basis for the “Declaration of Assurance” of the F4E Director.

During 2015 F4E continued improving how the different assurance functions interact together in a constructive and efficient manner. In particular, the central database – RAPID – which centralises all the main findings, observations and recommendations, was upgraded and is extensively used within F4E. RAPID is organised around the IMSS and allows reporting on the findings classified per Standard.

Assurance Strategy on Grants and Procurement Contracts

F4E’s ‘Assurance Strategy on Grants and Procurement Contracts’ was revised in 2014 and presented to the Audit Committee. For F4E grants, which are similar to the FP7 and Horizon 2020 grants of the European Commission, the costs are reimbursed on the basis of declarations of costs incurred by the beneficiaries and therefore have to be subject to ex-post verifications in order to ascertain their legality and regularity. These ex-post audits are outsourced via a framework contract concluded between the European Commission Directorate Generals related to Research and Innovation, Energy, and Communication Networks, Content and Technology (Research DGs), Agencies of the European Commission and three external audit firms. For procurement contracts which are based on agreed-upon prices, the same principles applied for ex-post controls on grants cannot be applied. Procurement contracts should, instead, be subject to controls on a much broader basis than the ex-post controls and verifications applied to grants. These controls are performed via audits or reviews (assurance engagements) carried out by the Internal Audit Capability of F4E and cover the financial, compliance, quality and performance aspects of contracts.

F4E grants account for a minimum portion of the F4E operational budget; in terms of 2015 operational payment appropriations, they represent only 1.25%. In order to efficiently use the resources available, the selection of beneficiaries to be audited focuses on the top beneficiaries who have not been previously audited by the Research DGs and Agencies of the European Commission or for which such audits resulted in significant findings. On this basis, in 2015 three audits were performed by the external audit service provider at beneficiaries from Spain, Portugal and The Netherlands and resulted in adjustments in the favour of F4E of EUR 26 thousand. F4E is in the process of implementing the audit results.

Corporate Internal Supervision Function

This function was established in 2013 to respond to the need of further control mechanisms after the decentralisation of the financial circuits. It is composed of the financial supervision (examining the financial transactions from a compliance and efficiency perspective) and the Internal Review Panel (examining the compliance aspects before the award of tenders).

As regards to the financial supervision, a second campaign was launched in 2015 analysing a sample of commitments, pre-financing, intermediate and final payments, looking at the time to contract and time to pay. The 2015 campaign confirmed the positive trend observed in 2014, where F4E achieved efficiency gains when comparing data before and after the decentralisation ranging from 20% reduction in the number of days spent to perform the payment process up to around 50% reduction in the number of days needed for the overall procurement lifecycle – from the publication of the Call for tender to the Award Decision.

The Internal Review Panel (IRP) reviews the correctness of the procedural aspects followed for contracts and framework contracts with a value equal to or above EUR 1million EUR and less than EUR 10 million and grants or framework partnership agreements with a maximum F4E contribution equal to or above EUR 400 thousand and less than EUR 4 million. In 2015, the Internal Review Panel met 11 times and reviewed ten contracts and three grants. In addition, the IRP issued general recommendations to F4E Senior Management on how to address recurring issues. This panel complements the Procurement and Contracts Committee (PCC), which provides the F4E Director with recommendations on the award of contracts above EUR 10 million and grants above EUR 4 million, and on strategies in relation to procurement and grant activities.

Quality Management System

In 2015, F4E continued the implementation and development of the Quality Management System through four main activity areas:

- Process development and reviewing;
- Quality Assurance in the operational projects;
- Quality audits (internal and external); and
- Continual improvement of the system.

Process Development and Reviewing

According to the ISO-9000 series and its quality management principles – a desired result is achieved more efficiently when activities and related resources are managed and documented as a process. The process approach is also a requirement of the IAEA Safety Requirements No. GS-R-3, that together with ISO-9001 are the standards adopted by F4E to comply with the ITER Project quality, safety and management requirements. The F4E quality system is a stakeholder-oriented system, taking into account equally:

(i) The requirement definitions;

(ii) The stakeholder feedback;

(iii) F4E compliance with the requirements.

Following this logic F4E moved further towards a 'process approach' by broadening its 'process map' to organise all of its processes showing the links between all activities to carry out across the organisation. As part of the Integrated Management System, an F4E Manual aims to closely mirror the evolution of the organisation and encourage a harmonised approach in the development and application of working procedures to achieve organisational objectives on all levels (corporate, departmental and individual staff objectives).

In the first half of 2015, and following a Staff Engagement Action Plan requiring 'the rationalisation of the F4E working procedures', F4E decided to simplify the 'Sign-Off Authority Policy' approach and to reinforce the process ownership in order to create better conditions to achieve this goal.

In the second half of 2015, and following the issue of the "F4E Policy on Evaluation in Operational Procurement Procedures", the procurement-related processes were updated incorporating the policy changes and were also subject to a simplification and rationalisation exercise.

In the same time, F4E started the 'Contract Management improvement' exercise, which included the joining of the processes for deviation and amendments. F4E also started developing an online database and an electronic tool, Contract Tracker, for the management of the contract modifications – related policies and processes for the development of the tool have been modified accordingly.

In 2015, the statistics of the process development were:

Processes Status	Total	Approved			In Development			
		Process	Procedure/ Policy	Updating	Software tool- based	Review	Mapped	Preparation
31 Dec 2015	173	127	18	10	2	8	1	110

Quality Assurance in Support to the Operational Projects

Quality Assurance (QA) is defined as part of quality management focused on providing confidence that quality requirements will be fulfilled.

One of the major QA activities is the support to the operational projects to ensure the correct implementation of the quality programme. This activity can be divided into:

– Support and review of the Procurement Arrangements and ITER Task Agreements to ensure conformance with the F4E QA Programme, the ITER IO-Domestic Agency coordination meetings in quality and safety and issue of the implementation templates;

– Full support to the technical departments on quality issues of contracts and grants, verification of the Call for tenders documentation (including full review of the management specifications) for compliance with the F4E QA Programme and issue of the follow-up documentation templates;

- Training on QA (and nuclear safety) to suppliers providing 'protection important class' items and/or services;

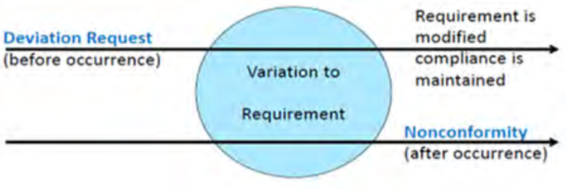
- Verification of the suppliers' quality plans and all the contract implementation quality documentation;

- Full support on QA to the kick-off and progress meetings, as well as the control point quality-related visits.

Another major QA activity is the coordination, registry and reporting of the **Nonconformities and Deviations:**

- Nonconformity is a non-fulfilment of a requirement. A Deviation is a planned alternative to a specified requirement. These requirements might come from the procedures, the items and services specifications or from the stakeholder.

- F4E has defined a process for handling all aspects of the detected nonconformities in line with ITER IO requirements. All F4E personnel are responsible for the identification and reporting of any detected nonconformity.



- Any deviation (or modification) to a specified requirement identified by F4E or the supplier shall be handled by the dedicated deviation procedure and the F4E configuration management process. A detailed process exists at F4E for the management of deviations.

- Nonconformities and deviations are addressed at F4E in a graded approach, where the most significant (higher impact on cost and/or performance) require a more strict control and review.

- In 2015 the main types of nonconformities (includes from Quality Audits) and deviations are represented in the tables below.

Nonconformities (F4E Classification)	**Cases**	**%**
Major (impact on customer critical requirements)	93	17%
Minor (impact on customer non-critical requirements)	257	48%
Relevant (impact on F4E contract, but not on customer requirements)	181	34%
Technical Exception (no impact on F4E contract or customer requirements)	3	1%
Total	534	-

- Corrective actions are triggered by the occurrence of nonconformity, in order to eliminate the cause and prevent repetition.

Deviations (F4E classification)	**Cases**	**%**
Level A (no impact on F4E contract or customer requirements)	8	2%
Level B (impact on F4E contract, but not on customer requirements)	169	39%
Level C (impact on customer requirements)	198	46%
Cancelled or still to be defined (in the process of assessment)	56	13%
Total	431	-

Deviations (by type)	Cases	%
F4E DR (deviation request by F4E, internally or to ITER IO)	54	13%
Supplier DR (deviation request by the supplier to F4E)	224	52%
ITER IO DR (deviation request by ITER IO towards F4E)	16	4%
Deviation Notice/Order (deviation by F4E towards supplier)	137	32%
Total	431	-

Quality Audits (Internal and External)

F4E has an established quality audit framework that provides F4E and its stakeholders (e.g. ITER IO) with the assurance that F4E is assessing the internal system and that our suppliers are being monitored and that quality is adequately being implemented. The methodology regarding the planning, preparation, implementation and recording of internal and external quality audits is defined in a related process.

The objective of the External Quality Audits is to verify that F4E suppliers comply with the Quality Plan and its effectiveness. The internal Quality Audit also aims at ensuring that operational teams comply with the F4E Quality system and ensure its effectiveness.

Each Quality audit result is presented in an audit report, which includes the identification of any strong areas describing the strengths of the Supplier Quality Plan, improvement areas and nonconformities. When improvements or nonconformities are identified, the report is followed by an action plan from the auditee to address the findings. At the end of the year the 'Annual Quality Plan' for 2016 was developed and approved for implementation.

The Supplier Action Plan once approved by F4E is follow-up to ensure its correct implementation and closure. This ensures the correct issue of Nonconformity Reports, the approval of the disposition of the remedial actions, the review of the remedial outputs, the corrective actions proposed and the closure of the nonconformities.

In 2015, out of the 20 quality audits planned:

Audits	Cases	%
External - Operational Contracts	16	80%
External - Grant or Partnership Agreements	2	10%
Internal on quality implementation	1	5%
Cancelled (due to contractual progress)	1	5%
Total	20	-

- One operational contract audit was cancelled due to the contract progress and amendment negotiations and will be proposed to be performed under the 2016 plan.

The global results of the quality audits are detailed in the table below:

Audit Result	Cases	%
With an Acceptable Result	18	90%
With an non-Acceptable Result	0	0%
Not yet finalised or cancelled	2	10%

These audits resulted in 177 findings, classified as follows:

Audit Finding	Cases	%
Strong Areas	17	10%
Improvement Areas	127	72%
Nonconformities	33	18%
Total	177	-

As foreseen in the related process, all the nonconformities found triggered a Nonconformity Report issued by the auditee with the action to address the weaknesses.

Continual Improvement of the Quality Management System in 2015

IMSS number 22 'Continual Improvement' requires F4E to continually improve the effectiveness of the Internal Management System standards through the use of the 'Quality Management Policy' , the 'Integrated Management System Policy', quality objectives, audit results, analysis of data, corrective and improvement actions and management review.

F4E implemented the following improvements in 2015:

(i) Simplification of F4E's 'Sign-Off Authority Policy' approach;

(ii) Update and issue of the overall 'Supplier Quality Requirements' document (ITER IO, 2015 version);

(iii) Update and improvement of F4E's 'Procurement Working Procedures';

(iv) Development of the 'Working Procedures Policy' and the related implementing instructions;

(v) Support to the development of a an electronic tool, Contract Tracker, by defining all the processes and specifications for the deviations and amendments modules;

(vi) Preparation of a 'F4E Documentation Assessment' to verify the adequacy of the F4E documentation system and its use, and propose its improvement;

(vii) 'Operational Quality Guidance 2015' training sessions to all operational officers;

(viii) Further Development of the F4E 'process map', including the related macro processes.

In relation to organisational efficiency, particular attention was paid during the past year on cost methods and processes, contract management processes, management of documentation and records, as well as the ITER IO Integrated Teams and the impacted working procedures.

Corrective Actions Taken and Conclusion

- All raised nonconformities, to be accepted, have to be presented with the correspondent Remedial Action (remedial to the specific situation) and the Corrective Action (action correct the cause on the nonconformity);

- All deviations are assessed for impact on performance, cost and schedule before the decision to accept them or not is taken. For level C deviations, an assessment by the customer is required before a decision is taken;

- All the Quality Audit improvement areas and nonconformities found where addressed in an action plan proposed by the entity being audited (suppliers in the case of external audits, F4E for internal). These action plans are subjected to the acceptance by F4E (or the Auditor if external) and must propose, especially for nonconformities, the corrective actions;

- The auditee Action Plan once approved by F4E is followed-up to ensure its correct implementation and closure. This ensures the correct issue of Nonconformity Reports, the approval of the disposition of the remedial actions, the review of the remedial outputs, the corrective actions proposed and the closure of the nonconformities;

- All the reported quality situations had a technical nature (documentation, performance and/or planning) and were adequately processed (including amendments, remedial and corrective actions) at the contract or procurement arrangement level.

Assessment of Audit Results during 2015

Internal Audit Service (IAS)

The Internal Audit Service of the European Commission (IAS) concluded two follow-up reports in 2015, a second follow-up audit report on Preparation of Procurement Arrangements and a first follow-up on the 'TB03 Competitive Dialogue audit'.

Regarding the 'TB03 Competitive Dialogue audit', once the action plan was implemented in September 2015, the IAS performed a first follow-up audit and concluded that six out of eight recommendations have been adequately implemented while two remain open until the effectiveness of the recent measures taken to address the risks can be assessed during a second visit. The first one 'Improve documentation of public procurement' was initially a 'very important' recommendation downgraded to 'important' after their follow-up. The second one 'Ensure adequate acceptance of deliverables contributed by third parties assisting the procurement' is a 'very important' recommendation which remains open as its effectiveness could not be assessed. In response to these conclusions, F4E issued four new actions in order to mitigate the remaining risks, which have already implemented and will be subject of a second follow-up during the first semester of 2016.

The IAS also conducted a second follow-up of the 'Preparation of Procurement Arrangements audit', concluding that out of the nine recommendations issued by the auditor and reported as implemented by F4E, seven were adequately implemented and for the two remaining ones they would re-assess the residual risk in the context of the new audit on 'Implementation of Procurement Arrangements' that is being finalised. There are two recommendations, one of which is 'critical', 'Adopt and implement a "Cost Estimates at Completion" policy'; and another which is 'very important', namely 'Upgrade the design and content of the IT tool(s) used for planning, reporting, and monitoring of the project'. It has to be stressed that in these two areas significant improvements have been achieved by F4E since the original recommendations were issued in 2012, as reported to the European Court of Auditors and the Discharge Authority.

In addition, in March 2015 the IAS concluded its Strategic Internal Audit Plan (SIAP) for the period 2015-2017, based on a risk assessment performed during 2014 and where the possible audit topics for the years to come were identified. In 2015 they started the audit on 'Implementation of Procurement Arrangements' for which no draft report has been received yet, and in 2016 they have launched an audit on 'Document Management and Information Security'. The SIAP also identified certain non-audited immature processes exposed to high inherent risk, for which F4E provided an action plan to mitigate those risks which are being closely followed up by F4E Management.

Internal Audit Capability (IAC)

In 2015 the IAC issued the following four final reports:

- Follow-up Audit Report on Grants Management (issued in April 2015);
- Follow-up Review Report on Operational Pre-Procurement Activities (issued in May 2015);
- Review of ABAC Access Rights (issued in May 2015);
- Follow-up Audit Report on Financial Circuits (issued in October 2015);

Following IAC's Contract Audit Strategy, two audit engagements were launched and largely completed in 2015, although the corresponding final reports will be issued in 2016:

- Audit of Contracts in the Area of ITER Neutral Beam and Electron Cyclotron Power Supplies and Sources;
- Audit of Contracts in the Area of Cryoplant and Fuel Cycle.

In addition to the assurance work, the IAC also assisted F4E's Management by providing consulting and advice. In particular, the IAC:

- Issued a consulting engagement report on the process for scientific and technical publications;
- Participated actively in the preparation of F4E's 'Anti-Fraud Strategy', formally approved by the F4E Governing Board in June 2015.

For the follow-up on the audit on grants management, the IAC concluded that 20 out of 25 recommendations were effectively implemented. Three recommendations were considered by IAC as 'not implemented' but as F4E did not take further action, therefore they were referred to the Audit Committee. One action was suspended, another was cancelled, and the third action was deemed to have lost pertinence. The recommendations referred to the Audit Committee were discussed and closed following the explanations provided by the F4E Management and their acceptance of the residual risks (which was assessed as 'Medium' by the IAC). The audit on grants management is now considered as formally closed.

Regarding the **follow-up on the audit on operational pre-procurement activities**, the IAC concluded that 23 out of the 31 recommendations had been effectively implemented. However, five recommendations were referred to the Audit Committee as according to the IAC the actions taken by F4E did not sufficiently mitigate the residual risks and F4E had not planned to take further action to address them. Three recommendations were kept open as F4E was in the process of implementing the related actions. The Audit Committee of May 2015 noted that the F4E Management accepted the residual risks and agreed that the remaining open actions should be closed, and with that, this audit is considered as formally closed.

In relation to the **second follow-up audit on financial circuits**, the IAC concluded that 38 out of 43 recommendations were effectively implemented, and the remaining five recommendations were assessed as partially implemented (two of which with 'low residual risk' and three with 'medium residual risk'). In response to these conclusions, F4E Management proposed additional actions to be implemented in the short-term to mitigate the remaining risks. On this basis, the audit on financial circuits was considered as implemented by both the IAC and F4E Management.

Finally, the 'Annual Review of the ABAC Access Rights Report' concluded that the access rights are generally in line with the delegations entrusted to the staff of F4E. The review resulted in three non-conformities, which have been resolved in the meantime, and three recommendations from the previous review were implemented and are now considered as closed.

European Court of Auditors (ECA)

In November 2015 the ECA adopted the final report on the 2014 annual accounts of F4E, where it expressed an unqualified opinion, meaning that in the Court's opinion:

- The Joint Undertaking's annual accounts present fairly, in all material respects, its financial position as at 31st December 2014 and the results of its operations and its cash flows for the year then ended;

- The transactions underlying the annual accounts of the Joint Undertaking for the year ended 31st December 2014 are, in all material respects, legal and regular.

In addition, the ECA have included an 'Emphasis of Matter' sub-section within the 'Statement of Assurance' in order to raise awareness on the problems faced by F4E and ITER IO in relation to the cost and schedule of the overall ITER project. As a consequence, the Budgetary Authority invited the F4E Director to the hearings both at the Council of the European Union and at the European Parliament in order to explain the measures taken to address these risks and concerns.

Finally, there is a number of observations that did not affect the assurance, but which in some cases should be addressed by F4E. The status of these observations is as follows:

Area	Implemented	In Progress	No Action	Total
Annual Activity Report			1	1
Host State agreement		1		1
Implementation of budget			1	1
Intellectual Property Rights and Industrial Policy		1	3	4
Operational procurement and grants	1		1	2
Overall control and monitoring of operational procurement contracts and grants (Internal Control)		1	2	3
Key controls of the Joint Undertaking's Supervisory and Control Systems		1		1
Presentation of the accounts		1		1
Rules implementing the Staff Regulations		1		1
Conflict of interest			1	1
Legal Framework	1			1
TOTAL	2	6	9	17

For the observations in progress, the status is the following:

- Host State Agreement: negotiations on the permanent premises are still ongoing but are expected to be completed in 2016;
- Intellectual Property Rights: F4E continues to implement the actions foreseen in the Intellectual Property Rights and Industrial Policy;
- Overall control and monitoring of operational procurement contracts and grants (Internal Control): F4E is continuing the implementation of its strategy on ex-post audits on grants;
- Key controls of the Joint Undertaking's Supervisory and Control Systems: Actions in response to main risks are pursued closely by F4E Management to adequately mitigate such risks and impacts;
- Presentation of the accounts: the revision of the ITER credit distribution along the life of the Procurement Arrangements is being addressed in conjunction with ITER IO;
- Rules implementing the Staff Regulations: F4E is assessing the latest Implementing Rules or model decisions adopted by the European Commission end of 2015/beginning of 2016 and will initiate the relevant steps.

Follow-up of Recommendations and Action Plans for Audits

The status of the implementation of the internal audit action plans as of April 2016 is as follows:

Overview per audit

Audit Name	Source	Recom-menda-tions	Actions	In Pro-gress	Imple-mented	Cance-lled	Obsolete	Imple-mented % (1)
Operational Pre-Procurement Activities	IAC	31	40	0	39	1	0	100%
Procurement in the area of ITER buildings	IAC	29	34	1	32	1	0	97%
Selection and recruitment	IAC	18	38	0	34	3	1	100%
Procurement Arrangements Audit	IAS	10	29	0	28	1	0	100%
Contracts monitoring in the area of buildings	IAC	13	24	0	23	1	0	100%
TB03 Competitive Dialogue Review	IAS	8	23	0	23	0	0	100%
Limited Review of Contracts Management-Entity-wide Controls in F4E	IAS	7	19	2	17	0	0	90%
		116	207	3	196	7	1	99%
				1%	95%	3%	1%	

Overview per criticality of actions

	In Progress	Implemen-ted	Cancelled	Obsolete	Total	Implemen-ted % (1)
Critical	0	12	1	0	**13**	**100%**
Very Important	1	102	5	0	**108**	**99%**
Important	2	74	1	1	**78**	**97%**
Desirable	0	8	0	0	**8**	**100%**
Total	**3**	**196**	**7**	**1**	**207**	99%
	1%	**95%**	**3%**	**1%**		

(1) Implemented % is equal to the number of actions implemented per total number of actions that can be executed (Cancelled and Obsolete actions are not taken into account)

Significant progress was achieved during 2015 and the beginning of 2016 in implementing all the action plans, as a a result of the strong focus put by F4E Management in this area of concern.

All action plans have been totally implemented except two: 'Procurement in the Area of ITER-Buildings' and 'Contracts Management entity-wide controls'. For the the first one, only one action is still in progress, with a revised target date for the end of June 2016. For the Contracts Management audit, only two actions are still in progress, and F4E is taking longer than planned to implement those because it is addressing the recommendation of the IAS on a wider basis than what was recommeded by the auditor. F4E is improving the management of contracts by developing a tool to manage contract changes and deviations through an electronic workflow with the main objective to efficiently contain costs during the contract implementation phase.

Follow-up of Observations from the Discharge Authority

For the financial year 2013, the European Parliament granted, in its plenary session of April 2015, the 'Discharge in respect of the implementation of the budget' to F4E and the closure of its accounts. They issued 32 observations with regards some aspects of the project, in particular in relation to the 'Emphasis of Matter' of the ECA raising concerns on the cost and schedule risks that F4E and the ITER project are currently facing.

F4E submitted in October 2015 a report to the European Parliament on the measures taken in the light of the observations accompanying the European Parliament's discharge decision for 2013, in accordance with in Article 110 of the Framework Financial Regulation. Out of the 32 observations of the European Parliament, four were reported as 'No Action' required from F4E, 16 were reported as 'Ongoing', nine as 'Implemented' and three as 'Partially Implemented'.

In relation to the 16 ongoing actions, F4E has continued working in its implementation. In particular, seven of these observations are related to the revised schedule that will be presented to the June 2016 ITER Council. Four other actions have been completed:

- Commitment of the ITER stakeholders to the project: this was confirmed by the European Commission who is the European representative at the ITER Council;

- Progress report of the project together with an assessment by the European Commission: the report was submitted in October to the Council of European Union and the European Parliament;

- Implementation of audit action plans: significant progress has been achieved in 2015 and beginning of 2016, achieving an implementation rate of 99% of the audit actions;

- The F4E Financial Regulation and its Implementing Rules have entered into force retroactively as of 1st January 2016. It has to be noted that the new procurement and grant rules will enter into force on 1st June 2016.

The status for the remaining five actions is the following:

- Revision of the ITER credit distribution along the life of the Procurement Arrangements: this action is being addressed in conjunction with ITER IO;

- Host State Agreement: Negotiations on the permanent premises are still ongoing but are expected to be completed in 2016;

- Rules Implementing Staff Regulations: F4E is assessing the latest Implementing Rules or model decisions adopted by the European Commission at the end of 2015/beginning of 2016 and will initiate the relevant steps;

- Actions in response to main risks are pursued closely by F4E Management to adequately mitigate such risks and impacts;

- Implementation of a definition of "fusion application": F4E has established a working definition of fusion/non-fusion application. This concept facilitates establishing the scope of the exclusive use of Intellectual Property rights generated within F4E contracts. Accordingly, the use of these rights can be granted to contractors depending on whether they are considered fusion/non-fusion related.

Risk Management

The Risk Management framework at F4E currently consists of two different levels: Corporate and Project. Project Risk Management was implemented in 2011, while Corporate Risk Management was implemented in the second part of 2012. The two levels are regularly updated and the information is shared, as appropriate, with ITER IO and the F4E suppliers.

For the Project Risk Register; during 2015 the risk logs of the Project Teams have been mostly migrated to Oracle Primavera P6 in order to improve the management of the information and the links with the projects' schedules. This is updated quarterly, based on the project update and also specific information from the suppliers when there is a signed contract. This information is shared with ITER IO on a regular basis.

The main categories of risk identified at the project level are the following:

1. Requirement/Scope Definition: risk regarding the definition and maturity of the requirements and the understanding of the scope of the project;

2. Design: risk regarding the design complexity, maturity, development and integration;

3. Stakeholder/Regulatory/Environmental: risk regarding 3 different categories, such as stakeholder (EU, ITER IO, F4E), Regulations and possible environmental risks;

4. Safety/Security/Quality: risk regarding safety, security and Quality risks;

5. Supply Chain/Contractor Capability: risk regarding the suppliers' aspect, e.g. lack of competition or unavailability of facilities;

6. Technology/Information Technology: risk regarding the status of the technology (R&D), IPR, and possibly either on IT or specific software;

7. Fabrication/Manufacture: risk regarding mainly uncertainties in manufacturing;

8. Construction Strategy/Construction: risk regarding the construction strategy or the construction itself;

9. Interface/Integration/Assembly: risk regarding the management of the interfaces both within this project and with other projects (DAs);

10. Testing/Operations: risk that can arise during the testing or operation phase. In most of the cases the operation is out of the scope of F4E projects.

The Corporate Risk log is updated twice a year and, following validation of F4E Senior Management, is presented to the Governing Board. The mitigation actions of those critical risks are followed up very closely in order to reduce or avoid the impact of the relevant risk.

During 2015, additional risks with impact on cost have been identified in the process of updating the F4E Estimate at Completion. These risks will be incorporated, as needed, in order to complete the full picture.

Regarding fraud prevention, a specific risk analysis was performed in the context of the F4E Antifraud Strategy which was adopted in July 2015.

Compliance and Effectiveness of Integrated Management System Standards (IMSS)

In the Annual Report 2014, two areas of improvement were identified as to be addressed by the organisation as a priority for 2015: 'Project Control and Contract Management' and 'Rationalisation of working procedures'. Those areas were the most affected by findings from internal and external auditors. Looking at the progress actually made in these two key areas for improvement, the following conclusions can be drawn:

- Project Control and Contract Management: Significant progress was achieved in 2015 by establishing a new Estimate At Completion (EAC) for the F4E in-kind contribution to the ITER project. F4E is contributing to the revised schedule of the overall ITER project that is expected to be adopted by the ITER Council in June 2016.

The new schedule might have an impact on the F4E EAC. The preliminary figures have shown a bigger effort of cost containment to ensure the respect of the cap budget allocated by the Budgetary Authority for the current financial perspective (until 2020). This cost containment effort will not succeed unless it is accompanied by strong processes in place to control the project evolution and especially the cost dimension.

Finally, the Reserve Fund process and its modalities of compensation are still to be developed. In particular, processes should be developed to be able to identify the change requests to be financed through the Reserve Fund and the compensation mechanism to put in place to claim back the budget advanced.

- Rationalisation of working procedures: Significant progress was achieved in 2015 as most of the internal audit recommendations were implemented, many of them related to the establishment/revision of procurement procedures. However, there is still a critical action related to the IAS recommendation on management of contract changes which F4E is taking too long to implement. The development of the policies, processes and tools in this core area of F4E business (considering that F4E operations have significantly moved from procurement to managing contracts) should be a priority to ensure a sound financial management of the activities.

  Furthermore, in relation to the operational processes identified by the IAS as to be enhanced (Procurement Arrangement processes, Configuration Management and System Engineering, monitoring and transfer of deliverables, etc.), it was decided to address them in the context of the setting up the Integrated Project Teams, due to their strong interfaces with the ITER IO process. This part is still to be addressed and in particular for which concerns the financial responsibilities that F4E Staff are handling within the Integrated Project teams.

At the beginning of 2016, an assessment of the implementation of the standards was performed as this is one of the elements considered in the 'Declaration of Assurance of the Authorising Officer'. The audit recommendations (IAS and IAC) and observations (ECA) still open at the end of 2015 were grouped by impacted standard (IMSS-Integrated Management System Standards), considering the level of risks involved. As a result, it was concluded that the most impacted standards which required more attention from F4E during 2016 were the following:

- IMSS 14 'Processes and Procedures' is the most impacted standard, due to the critical recommendation from the IAS on contract management, which is taking longer to implement than foreseen. In addition, the adoption of Integrated Project Teams will pose some challenges in terms of alignment of processes between ITER IO and F4E. This will be an area of attention in 2016 for F4E, also considering that the entry into force of the new Financial Regulation which will imply the revision of many of the procurement processes;

- IMSS 19 'Management Information and Reporting' and IMSS 20 'Management Supervision' are the second-most impacted standards. These are intrinsically related, due to the ECA observations on the 'Emphasis of Matter', in relation to the respect of the multi-annual budget cap, the unreliable schedule and the lack of a system at contract level to regularly monitor cost deviations. Actions are being taken at the highest governance levels of the ITER project to address the concerns of the ECA, in particular with the revision of the project schedule to be presented to the ITER Council of June 2016.

- In addition, MSOI carried out a light self-assessment of the implementation of the standards at the beginning 2016. This review concluded that the IMSS were generally complied with, except for IMSS 18 Business Continuity, where the organisation is still working in establishing a Business Continuity Plan (BCP). The first steps towards the completion of this plan have been achieved, with the conclusion of a Business Impact Assessment (BIA).

As a conclusion, the IMSS are, to the best of our knowledge, effectively implemented in F4E, with improvements necessary notably for IMSS 14, 18, 19 and 20. In any case, further enhancing the effectiveness of the F4E control system in place, by inter alia taking into account any control weaknesses reported, is an on-going effort in line with the principle of continuous improvement of management procedures.

In order to address these weaknesses and reinforce these standards in a clustered and coordinated manner, F4E is further improving in 2016 the following areas:

- Cost control policies, tools and procedures;

- Contract management policies, tools and procedures;

- Project planning and budget aligned with the realistic schedule, allowing the monitoring of the degree of advancement of works;

- Integrated processes (including reserve fund and Integrated Project Teams with special focus on compliance aspects.

Management Assurance – Review of the Elements Supporting Assurance

The main elements supporting the assurance of the F4E Director are the following:

- Observations of the European Court of Auditors;
- Reporting of the Internal Audit Service and the Internal Audit Capability;
- Results of the F4E corporate internal supervision functions;
- Results of the ex-post controls on grants;
- Corporate Risk assessment;
- Annual external assessment of F4E;
- Declarations of the Authorising Officers by Delegation and Sub-delegation.

These elements are described in detail in the "Control Environment" section of this chapter. The "Overall control and monitoring strategy" adopted in 2012 by the F4E Governing Board contributes to the "assurance chain" of F4E.

The main objective of this strategy is to provide reasonable assurance to the F4E Director and external stakeholders on the state of internal control in F4E. It also sets out the framework to ensure that operational and financial transactions are implemented to the highest standards expected for such a project as ITER and to allow a close monitoring of the overall internal control system in place.

The Declaration of Assurance of the F4E Director can be found in the Annex section of this publication.

Information and Communication Technology

During 2015, the main achievements in the area of Information and Communication Technology (ICT) were the following:

- The **F4E intranet (F4ENet)** was migrated to a new platform and went live in October, 2015;

- The new **Dual Use Item Tracker (DUIT)** has been released. The application facilitates the mandated recording and traceability of dual use items (products and technologies which are normally used for civilian purposes but which may have military applications) being transferred to or from the F4E premises;

- A new release of the **Mission Management (MiMa)** application simplifies the mission order request process by putting the traveller directly in contact with the travel agent. The result is a reduction in the time required to issue confirmed bookings and some corresponding cost savings on travel and accommodation costs;

- Additional Payment **eSignataires** released. Specific templates have been released to allow staff of the F4E Site and Building and Power Supplies (SBPS) Project Team in Cadarache to benefit from the eSignataire solution to manage payments;

- A new major release of Contract Tracker (CTS) fundamentally simplifies the interactions between suppliers and F4E Technical Project Officers in the day-to-day management of operational contracts. Contract Tracker facilitates contract delivery management and automatically generates the Control Plan and Document Schedule as defined in the Quality Assurance policy, QA 115;

- A first process related to **Contract Changes (DOMS)** was implemented;

- A **Baseline Change Management application** was developed and released;

- A **Business Process Management platform** was selected and a pilot was carried out during 2015;

- The **Business Impact Analysis** exercise, which started in 2014 under the guidance and coordination of the ICT Unit, was completed. Results will be presented to Senior Management at the beginning of 2016;

- **Enterprise Resource Planning (ERP) Initiative**: The ICT Unit was involved in the ERP initiative started by the acting Director. A vision document, project charter document, and risk table were drafted. A Gap analysis focusing on existing issues with respect to Data, Processes and Applications was carried out;

- In the area of **IT Security** the ICT Unit performed penetration tests, risk assessments, security and vulnerability assessments of the ITER Collaborative Platform (ICP) environment (including applications like the document management system IDM, Contract Tracker and eSignataire), the WiFi infrastructure and the SGTI platform (the information system used by the Site and Buildings and Power Supplies Project Team);

- ICT infrastructure underwent further re-organisation, including the migration of the complete pre-production environments to the secondary datacentre;

- ICT Service monitoring: a tool for service monitoring was deployed and configured. At the end of the year more than 20 services/applications are monitored according to capacity and availability criteria;

- The pilot for the **virtualisation of 3D software (3D-VDI)** was completed, and during 2015 the service was released to a first selected group of users who confirmed their full satisfaction with the product;

- Release of two new e-mail features:
  - o "Get your voicemail in an e-mail": an audio file is attached to an e-mail and delivered to your mailbox whenever someone leaves a message in your voice mail;
  - o "Personal Mail Management": to manage quarantined e-mail messages.
- **Survey on the ICT Service Desk**: On-going support for all F4E users has been regularly provided with a high degree of customer satisfaction (90% survey approval rating);
- **ICT Service Desk.** During 2015, 4 765 requests (2 555 incidents, 2 210 service requests) were received and as many were resolved. The overall backlog at the end of the year was 32 open requests (14 incidents, 18 service requests).

Corporate Services

During the year, delivering better services and cost-efficiency have been paramount: for example, by changing F4E's electricity supplier, cost-savings have been made while increasing the share of renewable energy now making up at least 30% of F4E's electricity consumption. The contract with the new catering provider aims to reduce costs, as well as ensure a stricter quality control. Calls for tender, amongst others related to publication subscriptions, as well as postal and courier services have also been launched. F4E's agreement with CIEMAT was renewed in order to continue the provision of numerous services to F4E in accordance with the Host Agreement.

Support has been given to the F4E Working Group in charge of the discussions about the F4E permanent premises by bringing expertise and analysis in particular through two technical and architectural studies on office space ("Technical assessment and guidelines for the F4E workplace in the CNMC building"; "Implementation analysis of F4E in the CNMC building").

Health and safety issues remain a core priority. In this respect, following a technical assessment of health and safety provisions in the F4E Barcelona building, guidelines have been set in order to align on the relevant Spanish legislation on the subject.

F4E's security and safety policy was adopted in order to align to the common practice in European Union Institutions/Agencies. Trainings in first aid and fire emergencies have been organised.

The transfers of some staff members from Barcelona to Cadarache have been facilitated with respect to the French laws, the Spanish Host Agreement and the Protocol on Privileges and Immunities of the European Union. Close liaison between F4E and the ITER IO Welcome Office have resulted in a smooth transition for the concerned staff members. A major outcome of the discussions with the French authorities was the delivery of a residence card to non-French staff members, as well as to their non-EU relatives, in order to facilitate the contacts with the French authorities.

During 2015, 4 157 visitors at the F4E Barcelona offices were accredited. Logistical support has continued to be provided to internal meetings (in total 5 928 meetings were held during the year at the F4E Barcelona office) and 151 office moves were organised within the building.

Communication and Stakeholder Relations

In relation to information and communication, one of the main objectives this year has been to share the technical progress of the various ITER components under F4E's responsibility with our target audiences. In close collaboration with our contractors we have developed compelling narratives to highlight the innovation and direct commercial benefits stemming from their involvement. Seven communication campaigns targeting European media, a photo tour in some of our suppliers' facilities and more than 20 audiovisual clips, have helped us to raise further awareness. The cooperation with key stakeholders by offering them the possibility to become more familiar with the political and strategic aspects of the project has also been a priority.

The signature of key contracts in the areas of Buildings and Infrastructure, Remote Handling, Neutral Beam, Electron Cyclotron Power Supplies and Sources have allowed us to maintain the interest of mainstream, financial and specialised media reporting on the European contribution to ITER. In order to engage more actively with some communicators we have carefully timed the release of material, issued complementary statements by our contractors, or planned side-events. This has been the case for the contract signed in the areas of Logistics and Transport, which was announced during the ITER Business Forum, and the delivery of the first European component to ITER, which was a joint initiative with the input of national authorities and F4E. We have contributed to the ITER IO media trip by means of presentations, technical briefings and tours on-site so that journalists grasp the scale of the project. In addition, we have worked with contractors who wished to organise media trips to showcase their contribution.

In terms of media coverage, we have counted 261 articles reporting directly on F4E and 1 592 social media references. Thanks to the release of new audiovisual clips which portray different technical and commercial achievements, F4E's YouTube channel has exceeded 209 887 viewings. This year we have included time lapse footage from the production of key components, interviews with contractors, integrated drone aerial views from the ITER construction site and visited the premises of laboratories to report on the potential of R&D. In parallel, we have strengthened our presence on Flickr, F4E's open to all and free to download image gallery, has proven successful in making more pictures available from a broad spectrum of tooling, equipment and infrastructure. The number of followers of F4E's Twitter account has also increased by almost a thousand, consequently allowing F4E to spread its message to science reporters and fusion enthusiasts.

F4E's collaboration with Euronews, Europe's most-watched news channel reaching 400 million households in 155 countries, has given the ITER project more visibility and coverage. The fact that the broadcaster was allowed to go on-site for the first time to highlight Europe's role as "host" and interviewed the Director-General of ITER IO, offered a good hook for the "hi-tech" programme. We have also been contributing with other ITER Domestic Agencies, by means of interviews and footage, to a Canadian film – currently in production – which presents the potential of fusion in the energy mix.

In terms of stakeholder relations, a communication has been carried out, in collaboration with the European Commission, to explain the discharge procedure. The transfer of the ITER file from the Directorate-General for Research and Innovation to the Directorate-General for Energy has triggered off a number of co-ordination meetings in order to define responsibilities and agree on a set of common messages. The presentations made at the European Parliament and the illustration of key facts and figures have been managed in close cooperation with other teams. Similarly, the regular meetings with ITER IO and EUROfusion have helped us capitalise on resources and avoid duplication of tasks and costs.

Business and scientific events have been important to promote different aspects of F4E's work. The ITER Business Forum was the main networking event which gathered a high number of participants to learn more about present and future commercial opportunities. More events have been organised by the Industry Liaison Officers (ILOs) in Italy, Sweden, France and Spain, and in some cases in collaboration with fusion laboratories, thus giving F4E the opportunity to reach out to new communities.

With respect to publications, F4E has rebranded the online and print version of its flagship publication, "F4E News", which covers a broad range of themes and offers audiovisual material in a more accessible way. We have improved the "F4E Annual Report" and the "F4E Highlights" by making them more visual, with more facts, figures and sharper texts.

In the area of internal communications, "F4E Talks" have continued to be very successful with our members of staff, offering them the possibility to learn from internal and external speakers about various fusion technologies, project management practices in large international projects, and science communication. The internal website has been improved with more emphasis on internal updates about key personnel matters and a number of campaigns have been organised to keep staff informed of new working methods and ways to improve our work environment.

Staff Committee

During 2015, the Staff Committee (SC) addressed the majority of its work programme goals while dealing with several other tasks in cooperation with the F4E Departments involved.

- In 2015 the Staff Committee representative participated to 29 External Selections and 8 Internal Selections. In addition to Staff Committees members, 21 staff members participated in selections representing the SC. During the year 2015 the Staff Committee has been involved in the review 24 vacancy notices with the aim to provide transparency of the process and fair treatment;

- During 2015 the SC has been asked by HR for consultation on the list of the Implementing Rules to be adopted by the European Commission in the framework of the 2015 reform, including a calendar and deadlines to submit draft/request for changes. The consultation – which concerned rules on CA/TA appraisal, and draft implementing rules administrative enquiries and disciplinary proceedings – ended in August 2015;

- Along the year the SC carefully followed F4E Management discussion on the new F4E building and its possible new locations in Barcelona. In particular, members of the SC visited the proposed new building, analysed proposed desks, offices and meeting rooms arrangement, reviewed reports provided by Spanish Authorities and F4E experts, checked the compliance with Commission standards (OIB) and provided comments on possible space optimisation;

- The 2015 SC budget of EUR 70 000 lowered from the initial one of EUR 75 000, upon request of the Management in order to contain expenses, has been employed to address staff-related concerns (such as welfare, support to children, social activities and clubs). The only budget line which experienced an increase, was the one related to kids' activities: the organisation of the first F4E Summer Casal has been more successful than initially expected and counted with the participation of many staff members. We reiterate the every year increasing request for support from the SC as well as higher interest on the activities of the SC shown by the staff members (as confirmed in the various surveys and the large list of attendants) and the importance of teambuilding and supporting the integration of new staff members. Although the number of staff members continues to increase the Staff Committee is decreasing the number of activities or the amount in co-financing to align with F4E budgetary constraints;

- On 27-28th April 2015, F4E hosted and the SC organized the 29th Assembly of Agency Staff Committees (AASC), a meeting that brings together representatives from Staff Committees from all EU Agencies twice per year in order to discuss common issues, exchange best practices and learn more about various topics related to EU staff concerns. It took was attended by 70 participants from 28 EU Agencies. The agenda covered topics such as contract renewals, the Joint Sickness Insurance Scheme and staff-related court cases;

- Effort has been devoted to improving the internal communication of the SC's tasks and activities towards the staff members, via a substantial increase of updates on the SC intranet section.

Annexes

Declaration of Assurance

I, undersigned, Johannes Schwemmer, Director of the European Joint Undertaking for ITER and the Development of Fusion Energy (F4E) in my capacity as Authorising Officer:

- State that I have reasonable assurance that:

    o the information contained in this report presents a true and fair view;

    o the resources assigned to the activities described in this report have been used for their intended purpose and in accordance with the principles of sound financial management;

    o the control procedures put in place give the necessary guarantees concerning the legality and regularity of the underlying transactions related to the 2015 annual accounts.

This reasonable assurance is based on my own judgment and on the information at my disposal, such as the observations of the European Court of Auditors, the Internal Audit Service and the Internal Audit Capability, the declarations of the Authorising Officers by Delegation and Subdelegation, the results of the F4E corporate supervision functions, the ex-post controls on grants and the annual external assessment of F4E.

- Without qualifying this reasonable assurance, I confirm that the system of internal control is being further enhanced in order to appropriately mitigate the risks observed by the European Court of Auditors in the "Emphasis of Matter" section of their annual report 2014:

    o The amount of the Joint Undertaking contribution to the construction phase of the ITER project is exposed to significant risks of increase, mainly resulting from changes in the scope of the project deliverables and due to the current schedule which is considered unrealistic;

    o In relation to these risks, the Joint Undertaking is still developing a central and uniform system to integrate all the operational data and to allow regular monitoring and controlling of estimates, costs and deviations;

    o Neither of these elements calls into question the legality and regularity of the underlying transactions of the 2014 annual accounts.

- Confirm that those risks do not question the legality and regularity of the underlying transactions in relation to the 2015 annual accounts.

- Confirm that those risks under the control of F4E are being addressed through the following actions:

    o Support the ITER International Organization in developing a realistic and sound revised schedule that takes into account the available resources and the cost dimension which are closely related;

    o Strengthen the F4E system to centrally monitor the cost estimates and deviations, existing since October 2015;

    o Continue to pursue measures ensuring the respect of the capped budget of EUR 6.6 billion (2008 values) for the period 2007-2020.

- Confirm that I am not aware of anything not reported here which could harm the interests of F4E and the European institutions in general.

Johannes Schwemmer
Director of Fusion for Energy
29th April 2016

Analysis and Assessment by the Governing Board

INTRODUCTION

Article 44 of the Financial Regulation states that

1. The authorising officer shall report to the Governing Board on the performance of his/her duties in the form of an annual activity report, together with financial and management information confirming that the information contained in the report presents a true and fair view except as otherwise specified in any reservations related to defined areas of revenue and expenditure.

The annual activity report shall indicate the results of his/her operations by reference to the objectives set, the risks associated with these operations, the use made of the resources provided and the efficiency and effectiveness of the internal control system. The internal auditor referred to in Article 75 shall take note of the annual activity report and any other pieces of information identified.

2. By no later than 15th June each year, the Governing Board shall send the Council, the European Parliament and the Court of Auditors an analysis and an assessment of the authorising officer's annual report on the previous financial year. This analysis and assessment shall be included in the annual report of the Joint Undertaking, in accordance with the provisions of the Statutes.

In light of the above, the GB Vice-Chairs conducted an analysis and assessment of the 2015 Annual Report on the basis of the comments made by the committees (AMC, TAP, and AC) and came to the following conclusions.

ANALYSIS AND ASSESSMENT

THE GOVERNING BOARD:

1. Notes that the Authorising Officer of Fusion for Energy (F4E) fulfilled the tasks given to him in Article 44 of the Financial Regulation.

2. Welcomes the overall achievements presented in the 2015 Annual Report.

3. Welcomes the presentation of the Annual Report, which gives a clear impression of progress in the fabrication of the ITER components with comprehensive reports on the major components with numerous illustrations and photographs.

For the Governing Board

Joaquín Sánchez
Chair of the F4E Governing Board
30th June 2016

GOVERNING BOARD COMPOSITION

Representing	Name	Role
Governing Board	Joachín Sánchez Stuart Ward	Chair Chair (until 30/06/2015)
Austria	Harald Weber Daniel Weselka	Representative Representative
Belgium	Alberto Fernandez Fernandez Eric van Walle	Representative Representative
Bulgaria	Troyo Dimov Troev	Representative
Croatia	Tonči Tadić Stjepko Fazinić	Representative Representative
Cyprus	Panicos Demitriades Anastassios Yiannaki	Representative Representative (from 17/08/2015)
Czech Republic	Pavel Pavlo Jan Kysela	Representative Representative
Denmark	Volker Naulin Lars Christensen	Representative Representative
Estonia	Ergo Nömmiste Rein Kaarli	Representative Representative
Euratom	Gerassimos Thomas Massimo Garribba Robert-Jan Smits András Siegler	Representative (from 29/09/2015) Representative (from 29/09/2015) Representative (until 28/09/2015) Representative (until 28/09/2015)
Finland	Kari Koskela Tuomas Tala	Representative Representative
France	Gabriele Fioni Maria Faury Daniel Verwaerde Bernard Salanon	Representative (from 27/11/2015) Representative (from 17/08/2015) Representative (until 26/11/2015) Representative (until 14/08/2015)
Germany	Harald Bolt Michael Stötzel	Representative Representative
Greece	Anastasios Youtsos	Representative
Hungary	Gabor Veres Kinga Lorenz Barbara Toth-Vizkelety	Representative Representative (from 29 /09/2015) Representative (until 28/09/2015)
Ireland	Miles Turner Bob Hanna	Representative Representative
Italy	Aldo Pizzuto Raffaele Liberali Eugenio Nappi	Representative Representative (until 02/10/2015) Representative (from 05/10/2015)

Representing	Name	Role
Latvia	Andris Šternbergs Kveps Gatis Maija Bundule	Representative Representative (from 04/08/2015) Representative (until 04/08/2015)
Lithuania	Sigitas Rimkevičius Stanislovas Žurauskas	Representative Representative
Luxembourg	Léon Diederich Gaston Schmit	Representative Representative
Malta	Ian Gauci Borda	Representative
Poland	Paulina Styczen Łukasz Ciupiński	Representative Representative
Portugal	Teresa Ponce de Leão Carlos Varandas Pedro Cabrita Carneiro	Representative (from 08/09/2015) Representative Representative (until 07/09/2015)
Romania	Florin Buzatu Florin Spineanu	Representative Representative
Slovak Republic	Štefan Matejčík Jozef Pitel	Representative Representative
Slovenia	Jože Duhovnik Igor Lengar	Representative Representative
Spain	Fernando Ballestero	Representative
Sweden	Pär Omling James Drake	Representative Representative
Switzerland	Xavier Reymond Ambrogio Fasoli	Representative Representative
The Netherlands	Cor Katerberg Wim Koppers	Representative and Vice-Chair Representative
United Kingdom	Steve Cowley Alison Wall Jane Nicholson	Representative (until 11/12/2015) Representative (from 14/12/2015) Representative

BUREAU COMPOSITION

Member	Name	Role
GB	Stuart Ward	Chair (until 30/06/2015)
Bureau	Joaquín Sánchez	Acting Chair (from 01/07/2015)
Bureau	Cor Katerberg	Vice Chair
France France	Jérôme Paméla Bernard Salanon	Representative Representative
Euratom	Massimo Garribba Andrea Carignani de Novoli	Representative (from 30/09/2015) Representative (until 29/09/2015)
Chair of Executive Committee Chair of Audit Committee	Lisbeth Grønberg Brian Gray	Representative Representative (from 02/10/2015)

ADMINISTRATION AND FINANCE COMMITTEE (AFC) COMPOSITION

Representing	Name	Role
AMC	Cor Katerberg	Chair
Germany	Michael Stoetzel	Vice Chair
Austria	Monika Fischer	Representative
Denmark	Lars Christensen	Representative
Finland	Sanna Häikiö	Representative
France	Domitille Laude	Representative
Hungary	Gábor Veres	Representative
Italy	Valentina Vaccaro	Representative
Spain	Guadalupe de Córdoba Lasunción	Representative
Sweden	James Drake	Representative
Switzerland	Patrice Soom	Representative
United Kingdom	Catherine Pridham	Representative
Euratom	Andrea Carignani di Novoli Giancarlo Sordon	Representative Representative

PROCUREMENT AND CONTRACTS COMMITTEE COMPOSITION

Representing	Name	Role
Ad Personam	Lisbeth Grønberg	Chair
Ad Personam	Jonas Amnéus	Representative (from 6/10/2015)
Ad Personam	Michel Bedoucha	Representative
Ad Personam	Maciej Chorowski	Representative
Ad Personam	Itziar Echeverría	Representative
Ad Personam	Fabrizio Felici	Representative
Ad Personam	Eric Hollis	Representative (from 6/10/2015)
Ad Personam	Julio Monreal	Representative
Ad Personam	Herkko Plit	Representative
Ad Personam	Federica Porcellana	Representative
Ad Personam	Pilar Ramiro	Representative
Ad Personam	Armin Scherber	Representative (until 23/11/2015)
Ad Personam	Herman ten Kate	Representative
Ad Personam	Pierre Van Doorslaer	Representative

EXECUTIVE COMMITTEE COMPOSITION

Representing	Name	Role
Ad Personam	Lisbeth Grønberg	Chair
Ad Personam	Michel Bedoucha	Representative
Ad Personam	Maciej Chorowski	Representative
Ad Personam	Itziar Echeverría	Representative
Ad Personam	Fabrizio Felici	Representative
Ad Personam	Simone Gruenhoff	Representative
Ad Personam	Julio Monreal	Representative
Ad Personam	Herkko Plit	Representative
Ad Personam	Don-Pierre Pompei	Representative
Ad Personam	Federica Porcellana	Representative
Ad Personam	Pilar Ramiro	Representative
Ad Personam	Herman ten Kate	Representative
Ad Personam	Pierre Van Doorslaer	Representative
Euratom (Vice-Chair)	Carles Dedeu Fontcuberta Pascal Petit Giancarlo Sordon	Representative Representative Representative

AUDIT COMMITTEE COMPOSITION

Representing	Name	Role
Audit Committee	Brian Gray	Member from 02/05/2014; Acting Chair from 02/10/2015
Ad Personam	Stuart Ward	Interim Chair from 19/03/2015 – 30/06/2015
Ad Personam	Paul Webb	Member (proposed by European Commission) from 20/02/2012
Ad Personam	Christian Scherf	Member (from 01/07/2014)
Ad Personam	Andreas Pott	Member (from 01/07/2014)

TECHNICAL ADVISORY PANEL

Representing	Name	Role
TAP	Joachín Sánchez	Chair
Ad-Personam	André Grosman	Vice Chair
Ad-Personam	Wolfgang Biel	Representative
Ad-Personam	Martin Cox	Representative
Ad-Personam	Flavio Crisanti	Representative
Ad-Personam	Horacio Fernandes	Representative
Ad-Personam	Pascal Garin	Representative
Ad-Personam	Marek Rubel	Representative
Ad-Personam	Vincent Massaut	Representative
Ad-Personam	Mathias Noe	Representative
Ad-Personam	Javier Alonso	Representative
Ad-Personam	Noud Oomens	Representative
Ad-Personam	Nawal Prinja	Representative

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ITER PROCUREMENT ARRANGEMENTS

Title	Credit (kIUA)	Signature Date
Ex-Vessel Remote Handling Transfer Cask System	17.31337	July 2015

Operational Procurement Contracts

Negotiated procedures (above EUR 250,000)

	Number	Value (EUR)
Negotiated above threshold	6	95,550,112

Awarded Contracts (* Negotiated Procedures)

Reference	Title	Contractor
F4E-OPE-635*	Procurement of W Monoblocks for the ITER Inner Vertical Target mock-ups and prototypes	Advanced Technology & Materials Co., Ltd.
F4E-OMF-405	Strand Characterisation of Nb3Sn TF Samples	DURHAM University
F4E-OMF-556	Provision of Planning and Scheduling services to support the existing F4E Planning and Scheduling team in the performance of their activities	BCF Solutions
F4E-OPE-552	Superconducting magnet system for the European Gyrotron prototype for the ITER	Cryogenic Limited
F4E-OMF-0563	Provision of material characterization at cryogenic temperatures (Lot 1) and room and elevated temperatures (Lot 2)	KARLSRUHE INSTITUTE of TECHNOLOGY
F4E-OPE-650*	Simulations of plasma response to magnetic perturbations generated by a combination of FI, TBMs and EFC in ITER	UKAEA
F4E-OMF-340 LOT 3	Multiple Framework Contracts in cascade for Remote Handling Systems (RHS) under nuclear environment: Neutral Beam Cell RHS	AMEC Nuclear UK limited
F4E-OPE-639*	Amendment to F4E–OPE–0583: Further Services provided by Chair of the IAIPS Expert Group	Mr Herkko Plit
F4E-OPE-649*	Small value contract for mirror sample procurement and feasibility testing of RF cleaning method	Universität Basel
F4E-OPE-0661*	Mirror samples supply using magnetron sputtering and pulsed laser deposition coating methods	Fraunhofer-Gesellschaft zur Foerderung der angewandten Forschung e.V.
F4E-OPE-0662*	Mirror samples supply using FCAPAD magnetron sputtering coating method	DIARC-TECHNOLOGY OY
F4E-OPE-0663*	Mirror samples supply using magnetron sputtering and ion beam evaporation techniques	THALES SESO SAS
F4E-OPE-638*	LTCC Magnetic Sensors	VIA ELECTRONIC GMBH
F4E-OPE-651*	Amendment #5 to OPE-305-04: Fabrication of the first wall component by an alternative two step Hip process	ATMOSTAT S.A.S
F4E-OFC-0569	Provision of Design Activities for the Design of Cooling Plants for the mm-Wave Components of the Four (4) Electron Cyclotron Upper Launchers	Iberdrola Ingenieria y Construccion SAU

F4E-OPE-646*	Post mortem analysis of the FS SSMUs	Commissariat à l'Energie Atomique et aux Energies Alternatives (CEA)
F4E-OMF-0567 Contractor 1	Additional supplier for divertor IVT: Competitive Framework Qualifying Suppliers for the Procurement of the ITER Full Tungsten Divertor Inner Vertical Target	ATMOSTAT SAS; ALCEN SAS
F4E-OMF-0567 Contractor 2	Additional supplier for divertor IVT: Competitive Framework Qualifying Suppliers for the Procurement of the ITER Full Tungsten Divertor Inner Vertical Target	CNIM
F4E-OMF-0567 Contractor 3	Additional supplier for divertor IVT: Competitive Framework Qualifying Suppliers for the Procurement of the ITER Full Tungsten Divertor Inner Vertical Target	RESEARCH INTRUMENTS
F4E-OFC-637	Handling, Storage and Transportation of the TBM fabrication material	Frazer Nash Midhurst Limited
F4E-OMF-557 LOT 2	Support QA/QC follow-up ANB Inspectors for the ESPN items of the ITER Project.	BUREAU VERITAS FRANCE
F4E-OPE-0665*	Provision of small quantities of ITER grade 316L(N)-IG metal powder for Electron Beam Sintering	CARPENTER POWDER PRODUCTS AB
F4E-OFC-608	Supervision and Health & Safety Support to F4E for on-site installation and commissioning activities under the Broader Approach Agreement	BUREAU VERITAS JAPAN
F4E-OMF-0578 LOT 1	Engineering Support in the area of Thermohydraulic and Fluidodynamic analysis	IDOM Ingenieria y Consultoria S.A.U.
F4E-OMF-0578 LOT 2	Engineering Support in the area of Thermohydraulic and Fluidodynamic analysis	IDOM Ingenieria y Consultoria S.A.U.
F4E-OPE-0672*	Engineering support on NDT-UT qualifications and inspection procedures for the Divertor Cassette Body prototypes	THE WELDING INSTITUTE
F4E-OPE-654*	PF Coils Impregnation Tooling and Additional Tooling	ELYTT ENERGY SL, ALSYOM SAS, SEIV
F4E-OPE-653*	Amendment 5 to the Support to the Owner Contract	Consortium Energhia (Halcrow Group Ltd, Idom, Altran Technologies)
F4E-OPE-0664*	Mirror samples supply using magnetron sputtering coating method	Compagnie Industrielle des Lasers CILAS
F4E-OPE-0674*	Consultancy Services in the field of occupational health and safety	URS ITALIA SPA
F4E-OPE-588*	Procurement of RF-Couplers for the RF Quadrupole	Instituto Nazionale di Fisica Nucleare (INFN)
F4E-OPE-0667*	Support for Prototype Procurement & Qualification of EC Isolation Valve	Centre de Recherches en Physique des Plasmas (EPFL-CRPP)
F4E-OPE-604	SUPPLY OF EUROFER-97 FINISHED PRODUCTS	Saarschmiede GmbH Freiformschmiecie
F4E-OPE-655	Design & Prototyping of integral and proportional data acquisition electronics for real time application	Scientific & Production Enterprise GYCOM
F4E-OPE-0702*	INDEPENDENT PROJECT ASSESSMENT REVIEW OF ITER BUILDINGS	HASTE
F4E-OMF-0660 LOT 1	Services for NBTF Site Supervision and Support	NIER Ingegneria S.p.A

F4E-OPE-278 LOT 1	AGPS -GRPS	NIDEC ASI SpA
F4E-OMF-383-01	Multiple Framework Contracts in cascade for Remote Handling Systems (RHS) under nuclear environment: In-Vessel Viewing System	CNIM; BERTIN TECHNOLOGIES
F4E-OPE-0687*	Supply of test hardware for the IPP neutral gas laboratory upgrades	TECNOLOGIA DE VACIO SL (TECNOVAC)
F4E-OPE-0712*	Amendment to OPE-622: JT-60SA TFC terminal insulation design	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES (CEA)
F4E-OPE-0693*	Supply of optical samples for the F4E-FPA-407: group 03	ISP Optics Latvia SIA
F4E-OPE-0734*	Performance Assessment of the Architect Engineer	Moreton Fields Ltd.
F4E-OPE-0736*	Consulting Services to Provide Support & Advice to the Acting Director of F4E	Johannes SCHWEMMER
F4E-OMF-633	Engineering Support Services in the area of Remote Handling	Oxford Technologies Ltd
F4E-OPE-0691*	Supply of optical samples for the F4E-FPA-407: group 01	CRYSTRAN LIMITED
F4E-OPE-0695*	Supply of optical samples for the F4E-FPA-407: group 05	COMPAGNIE INDUSTRIELLE DES LASERS C
F4E-OPE-0697*	Supply of optical samples for the F4E-FPA-407: group 07	DIARC-TECHNOLOGY OY
F4E-OPE-0690*	Cutting of Beryllium Components	ATMOSTAT SAS
F4E-OPE-0727*	Workshop "Safety Aspect and Regulatory Requirements related to Fusion Reactors in France"	EUROPEAN NUCLEAR SAFETY TRAINING AND TUTORING INSTITUTE
F4E-OPE-0730*	ESTIMATION OF THE COST AND DURATION OF THE MANUFACTURING OF THE BLANKET COOLING MANIFOLD SYSTEM	DOCKWEILER AG
F4E-OFC-0686-LOT2	OIS fasteners for JT-60SA	TDI
F4E-OPE-0704*	Supply of optical samples for the F4E-FPA-407: group 09	THALES SESO SAS
F4E-OPE-0692*	Supply of optical samples for the F4E-FPA-407: group 02	II-VI Deutschland GmbH
F4E-OPE-0694*	Supply of optical samples for the F4E-FPA-407: group 04	Solaris Optics S.A.
F4E-OPE-636	Site Infrastructure Works TB16	Spie Batignolles TPCI; Valerian; ATELIERS DE FOS
F4E-OPE-652	Testing of the SP1 Bis Semi-prototype	ALPHYSICA GMBH
F4E-OPE-0570*	PF Coils 2-5 Manufacturing and Cold Test	CNIM
F4E-OPE-0739*	IN-VESSEL COMPONENTS TEST FACILITY - Be LABORATORY INSPECTION	Culham Science Centre (CCFE)
F4E-OPE-0703*	Supply of optical samples for the F4E-FPA-407: group 08	Schott Suisse SA
F4E-OPE-0737*	JT-60SA TF-Coil 1m long conductor samples” by assessing the hydraulic performances in terms of nitrogen mass flow rate vs. pressure drop in the range 200 to 6000 Reynolds numbers	CEA (COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES)

F4E-OPE-0673	Concrete Testing	GINGER CEBTP
F4E-OPE-0731*	Potential Breaks for JT-60SA TF Coils	Babcock Noell GmbH
F4E-OFC-620 LOT 1	Provision of System and Instrumentation Engineering Support	VITROCISET SpA.
F4E-OPE-0668 LOT 1*	Manufacturing of additional magnetic sensor prototypes (Type 2) based on LTCC technology	ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE
F4E-OPE-0668 LOT 2*	Manufacturing of additional magnetic sensor prototypes (Type 2) based on LTCC technology	TEKNOLOGIAN TUTKIMUSKESKUS VTT OY
F4E-OPE-0738*	Cost estimate for the Divertor IVT series Production	Ansaldo Nucleare Spa
F4E-OPE-0718*	Supply of the Niobium Titanium material	Marphil International
F4E-OPE-0705*	Supply of signal detector emulator equipment for the FPA-327	ATI Sistemas, S.L.
F4E-OPE-648*	Acquisition of a Photogrammetry Camera	NUB3D, S.L.
F4E-OPE-0743*	COMPUTATION OF 3D EDDY AND HALO CURRENTS DURING	CREATE — Consorzio di Ricerca per l'Energia e l'Applicazioni Technologiche dell'Electromagnetismo, SRS Engineering

Administrative Procurement Contracts

Summary by type of procedure

Type of Procedure	Number	Value (kEUR)
Open	0	0
Restricted	0	0
Negotiated	4	1,790,000
Re-opened competition implementing a Framework	1	33,500
Total	**5**	**1,823,500**

Negotiated Procedures above EUR 60,000

Reference	Title	Contractor	Type
F4E-AFC-0613.01	Provision of Medical Services - Lot 1 - Medical Centre	Creu Blanca	Framework Service Contract
F4E-AFC-0613.02	Provision of Medical Services - Lot 2 - Medical Advice	Gabinete SME	Framework Service Contract
F4E-AFC-0613.03	Provision of Medical Services - Lot 3 - Medical Controller	Tebex	Framework Service Contract
F4E-AFC-0634.01	Complementary Health Insurance Services	Sanitas	Framework Service Contract

Awarded Contracts

Reference	Title	Type
F4E-2011-FW-36.02	F4E audit of accounts	Re-opening of competition implementing a Framework
F4E-AFC-0613.01	Provision of Medical Services - Lot 1 - Medical Centre	Negotiated
F4E-AFC-0613.02	Provision of Medical Services - Lot 2 - Medical Advice	Negotiated
F4E-AFC-0613.03	Provision of Medical Services - Lot 3 - Medical Controller	Negotiated
F4E-AFC-0634.01	Complementary Health Insurance Services	Negotiated
F4E-AMF-0576.03	Legal services in the field of Construction Contracts	Negotiated

Grants

Grants (* Unique Beneficiary)

Reference	Agreement Description	Beneficiary
F4E-FPA-603 Action 1	EUROFER97 code qualification and design rules development	Commissariat à l'énergie atomique et aux énergies alternatives (CEA)
F4E-FPA-603 Action 2	EUROFER97 material characterization	Karlsruhe Institute of Technology (KIT)
F4E-GRT-572	Preliminary study of Beryllium tile repair technologies	UKAEA
F4E-GRT-645*	DEMONSTRATION OF ADDITIVE MANUFACTURING AS FABRICATION METHOD OF 316L-GRADE COMPONENTS	Chalmers Tekniska Högskola AB (Chalmers Universtiy of Technology)
F4E-GRT-0682*	Optimization of the Central Divertor Cassette Exchange Process	Teknologian tutkimuskeskus VTT
F4E-FPA-611 Action 1	Development of simulation tools for the exploitation of the HCLL and HCPB TBS operation in ITER	Fluidyn France Sarl
F4E-FPA-611 Action 2	Development of simulation tools for the exploitation of the HCLL and HCPB TBS operation in ITER	Karlsruhe Institute of Technology (KIT) & Agenzia NAZIONALE PER LE NUOVE TECNologie
F4E-GRT-640	Development of a Measurement System of Induced Voltages in Ferromagnetic Structures	Consorzio CREATE
F4E-GRT-0689*	Development of Remote Diagnostics and Computer Aided Teleoperation Tools	Teknologian tutkimuskeskus VTT & TTY Foundation

Job Screening Exercise

Screening type	Screening category	Description	Year *n-1* (%)	Year *n* (%)	Year n total (%)
Administrative Support and Coordination (overhead)		**Administrative support**			16,84%
	DOC	Document management	-	0,42%	
	HR	Human resource management	-	4,84%	
	IA	Internal auditing and control (procedural aspects)	-	0,42%	
	ICT	Information and communication technologies	-	6,11%	
	LOG	Logistics, facilities management and security	-	2,53%	
	RES DIR/HoA	Head of Administration	-	0,42%	
		Coordination			
	LEGAL	Legal (administrative matters, including DP)	-	0,42%	
	COMM	External communication & information	-	1,47%	
	GEN COORD	General coordination activities	-	0,21%	
Operational	TOP COORD	Top operational coordination (Director/HoD)	-	3,58%	73,68%
	PGM M/IMP	Programme management and implementation	-	64,42%	
	EVAL	Evaluation and impact assessment	-	1,47%	
	GEN OPER	General operational activities	-	4,21%	
Neutral	FIN/CONT	Finance, accounting, contract management, administrative procurement, quality management, and internal audit and control (with focus on financial aspects)	-	9,47%	9,47%
	LING	Linguistic activities	-	0,00%	

Results: Job Screening Exercise

List of Acronyms

A/E	Architect Engineer
AC	Audit Committee
AFC	Administration and Finance Committee
ANB	Authorised Notification Body
ATO	Analysis Task Order
BA	Broader Approach
BASC	Broader Approach Steering Committee
BAUA	Broader Approach Units of Account
BCM	Blanket Cooling Manifold
BSM	Blanket Shield Module
BTP	Build-to-Print
CAD	Computer Aided Design
CB	Cryostat Base
CCFE	Culham Centre for Fusion Energy
CEA	Le Commissariat à l'Énergie Atomique et aux Énergies Alternatives
CFTM	Cyclic Fatigue Test Module
CIEMAT	Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas
CMM	Cassette Multifunctional Mover
CN-DA	Chinese Domestic Agency
CPRHS	Cash and Plug Remote Handling System
CREATE	Consorzio di Ricerca per l'Energia e le Applicazioni Tecnologiche dell Elettromagnetismo
CRPP	Centre de Recherches en Physique des Plasmas
CS	Central Solenoid
CVB	Cold Valve Boxes
CVBCS	Cryostat Vessel Body Cylindrical Section
CW	Continuous Wave
DA	Domestic Agency
DC	Direct Current
DEMO	Demonstration Fusion Reactors

DNV	Det Norske Veritas
DNB	Diagnostic Neutral Beam
DTP	Divertor Test Platform
EBBTF	European Breeding Blanket Test Facilities
EC	Electron Cyclotron
ECH	Electron Cyclotron Heating
ECRH	Electron Cyclotron Resonance Heating
ECWG	Export Control Working Group
EFDA	European Fusion Development Agreement
EHF	Enhanced Heat Flux
ELM	Edge Localised Mode
EPC	Engineering Procurement Contract
ESC	Engineering Support Contract
EU	European Union
EUROFER	A 9% Cr reduced activation ferritic-martensitic steel
EUROFER ODS	Oxide Dispersion – Strengthened version of EUROFER steel
ExCo	Executive Committee
FC	Framework Contract
FW	First Wall
FZK	Forschungszentrum Karlsruhe
GB	Governing Board
GS	Gravity Support
HCLL	Helium-Cooled Lithium-Lead
H&CD	Heating & Current Drive
HFTM	High Flux Test Module
HIP	Hot Isostatic Pressing
HNB	Heating Neutral Beam
HTS CL	High Temperature Superconducting Current Leads
HV	High Voltage
HVPS	High Voltage Power Supply
HWR	Half Wave Resonator
I&C	Instrumentation and Control
IC	Ion Cyclotron
ICH	Ion Cyclotron Heating
ICRH	Ion Cyclotron Resonance Heating
IFERC	International Fusion Energy Research Centre
IFMIF	International Fusion Materials Irradiation Facility
ITER IO	ITER International Fusion Energy Organization

ITER IO CT	ITER International Fusion Energy Organization Central Team
IP	Intellectual Property
IPP	Max-Planck Institut fuer Plasmaphysik
ISEPS	Ion Source and Extraction Power Supplies
ISS	Isotope Separation System
ITA	ITER Task Agreement
IUA	ITER Units of Account
IVT	Inner Vertical Target
IVVS	In-Vessel Viewing System
JA-DA	Japanese Domestic Agency
JAEA	JA Implementing Agency
KIT	Karlsruhe Institute of Technology
LIPAc	Linear IFMIF Prototype Accelerator
LN2	Liquid Nitrogen
LPCE	Liquid Phase Catalytic Exchange
MAC	Management Advisory Committee
MEBT	Medium Energy Beam Transfer
MFG	Motor Flywheel Generators
NB	Neutral Beam
NBI	Neutral Beam Injector
NBTF	Neutral Beam Test Facility
NbTi	Niobium Titanium
NHF	Normal Heat Flux
ODS	Oxide Dispersion Strengthened
OIS	Outer Intercoil Structure
PA	Procurement Arrangement
PF	Poloidal Field
PID	Plant Integration Document
PIE	Post Irradiation Examination
PPC	Pre-Production Cryopump
PrSR	Preliminary Safety Report
PS	Power Supply
PTC	Prototype Torus Cryopump
Q1/2/3/4	Quarter
QA	Quality Assurance
QMS	Quality Management System
QPC	Quench Protection Circuit
RAFM	Reduced Activation Ferritic Martensitic

RCC-MR	Règles de Conception et de Construction des Matériels Mécaniques des Îlots Nucléaires RNR
REMS	Radiological and Environmental Monitoring Systems
RF	Radio Frequency
RFQ	Radio Frequency Quadrupole
RH	Remote Handling
RMP	Resonant Magnetic Perturbation
RWM	Resistive Wall Mode Control
RWMPS	Resistive Wall Modes (Coils) Power Supplies
SCMPS	Superconducting Magnets Power Supplies
SDC	ITER SDC (Structural Design Criteria/Code)
SHPC	Safety and Health Protection Coordination
SLA	Service Level Agreement
SNU	Switching Network Unit
STAC	ITER Science and Technology Advisory Committee
STC	Single Tender Contract
STP	Satellite Tokamak Programme
SWG	Special Working Group
TAP	Technical Advisory Panel
TBM	Test Blanket Modules
TF	Toroidal Field
TÜV	Technischer Überwachungs - Verein
US-DA	United States Domestic Agency
UT	Ultrasound Testing
VC	Voluntary Contributor
VV	Vacuum Vessel
WBS	Work Breakdown Structure
WDS	Water Detritiation System
WP	Work Programme
WRS	Warm Regeneration System

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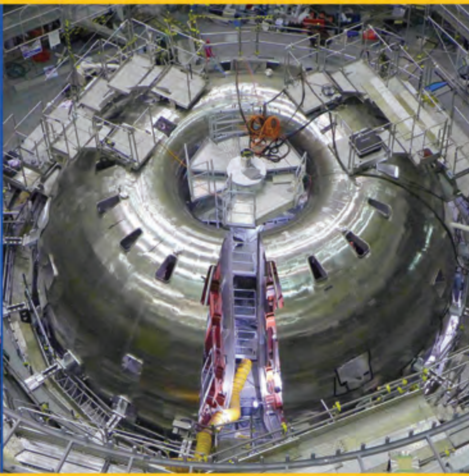

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