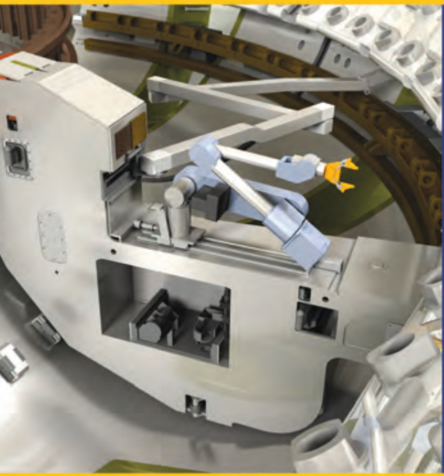
FUSION FOR ENERGY

ANNUAL REPORT 2014



FUSION FOR ENERGY

Annual Report 2014

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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.
Director(s):	Henrik Bindslev (from 1 January 2013 – 28 February 2015) Pietro Barabaschi (Acting Director from 1 March 2015 – Present)
Governing Body:	Governing Board (Chair: Stuart Ward, Members: 28 EU Member States, Euratom and Switzerland)
Subsidiary Bodies:	Bureau (Chair: Stuart Ward, seven Members) Administration and Management Committee (Chair: Cor Katerberg, 11 Members) Procurement and Contracts Committee (Chair: Lisbeth Grønberg, 13 Members) Technical Advisory Panel (Chair: Joaquin Sánchez, 13 Members) Audit Committee (Chair: Stuart Ward, five Members)
Staff:	393 (249 Officials and Temporary Agents and 144 Contract Agents)
2014 Budget:	EUR 897.4 million in commitment appropriations EUR 550.6 million in payment appropriations
Budget Implementation:	100.0% in commitment appropriations (unchanged compared the original budget) 89% in payment appropriations (73% compared to the original budget)
Operational Contracts:	61 signed for a total value of EUR 391 million (71 launched)
Administrative Contracts:	121 signed for a total value of EUR 8.7 million (7 launched)
Grants:	7 signed for a total value of EUR 14 million (8 launched)
Procurement Arrangements:	Two signed for the ITER Project – 8.2 kIUA (equivalent to EUR 13.8 million) bringing the total to 944 kIUA (approx. EUR 1.59 billion) out of a total 1108 kIUA (approx. EUR 1.9 billion) i.e. 85%. Six signed for the Broader Approach – 20.46 kBAUA (equivalent to EUR 13.872 million, 2005 value, non-escalated for inflation) bringing the total to 436.213 kBAUA (equivalent to EUR 295.8 million, 2005 value) out of a total of 500 kBAUA foreseen
Contributions to ITER	74.2 kIUA (equivalent to EUR 125 million) of which 19.4 kIUA (EUR 32.7 million) was for work under Procurement Arrangements, EUR 79.4 million in cash contributions to ITER, 1.1 kIUA (EUR 1.9 million) was for staff contributions and 6.6 kIUA (EUR 11 million) was for contributions under ITER Task Agreements
Meetings of Statutory Bodies:	Two of the Governing Board, six of the Bureau, two of the Administration and Finance Committee, six of the Executive Committee, two of the Technical Advisory Panel and two of the Audit Committee

Foreword by the Chair of the Governing Board

This is the seventh Annual Report of Fusion for Energy (F4E) — the European Joint Undertaking for ITER and the Development of Fusion Energy. Fusion for Energy, as Europe's ITER Domestic Agency (DA), is providing almost one half of the components for ITER. Many of these components are now being manufactured, and are beginning to be delivered to the ITER site at Cadarache in France.

ITER is a major international project at the cutting edge of science and engineering development. It is an ambitious scientific and technical undertaking which brings together 34 countries representing over half of the world's population: China, India, Japan, Korea, Russia, United States and Europe, representing the 28 countries of the European Union together with Switzerland.

Throughout this Annual Report there are many reports and pictures that illustrate the progress we are making. At the project's site in Cadarache, France the first level of the basement of the building that will house the ITER device was completed. This will support a total weight of some 400,000 tons, more than the weight of New York's Empire State Building. There are also many other visible signs of progress on the ITER construction site; for example the first parts of the 60 metre high metallic structures of the assembly building have been erected.

In other areas of ITER technology under F4E's responsibility (the magnet systems, vacuum vessel, in-vessel systems, fuel cycle systems, plasma heating systems, diagnostics and test blanket modules), this Annual Report testifies to good progress. Almost 90% of the principal items to be procured by F4E are now agreed and F4E is moving fully into the oversight of the manufacture and industrial fabrication of components for ITER.

In 2014 F4E signed 61 operational contracts with a value approaching EUR 400 million. By the end of 2014 the total value of the 300 contracts and 120 grants awarded by F4E since 2007 exceeded EUR 3,200 million. Through these contracts F4E supports people in over 20 EU Member States and Switzerland who are working in more than 250 European companies and over 50 R&D organisations engaged in cutting edge R&D, design, manufacture and fabrication work.

Considering the ITER Project as a whole, progress in the achievement of milestones continues to be slower than planned. A major management review in 2013 of the ITER International Organization (ITER IO) by a team from Madia Associates made a comprehensive set of recommendations. These are being implemented, but have been overtaken by the decision of the ITER Council in November 2014 to nominate Dr Bernard Bigot as the incoming Director General; Dr Bigot was subsequently confirmed as DG in March 2015. Until his appointment Dr Bigot was Administrator of the CEA in France and a member of F4E's Governing Board. Dr Bigot has taken a robust view of the need for changes in the project and its organisation and it will undoubtedly improve for the better over the coming year.

The collaboration between Europe and Japan known as the "Broader Approach" is proceeding well. The "Helios" supercomputer, located in Rokkasho, was installed during 2012 and the fusion research communities in both Japan and Europe have started to use it intensively; to date some 336 papers have been accepted or published in scientific journals including 12 papers in Physical Review Letters. The refurbishment of the Japanese tokamak, JT-60SA, continues apace, with components being delivered by a number of European countries including Spain, France, Germany and Italy; some 80 conductors in total for the TF coils were manufactured and tested by the end of 2014. The Japanese completed the manufacture of two vacuum vessel 30-degree sectors and one 20-degree sector was completed in February and in April and certified in May. The Injector installation and check-out phase for IFMIF/EVEDA was successfully completed by October and the first beam was obtained in November 2014. The EVEDA Lithium Test Loop in Oarai has successfully demonstrated stable lithium flow for IFMIF operating conditions and has now completed its mission.

The F4E Governing Board (GB) met on two occasions during 2014. The main business of the Board has been the scrutiny of progress to date and the consideration and approval of future plans. However, the Board has revised its own Statutes in the light of the accession of Croatia to the European Union. It also took the opportunity to update other aspects on the Statutes that would improve its effectiveness as a Board. (These revised Statutes were adopted by the Council of the European Union in January 2015).

The GB has paid close attention to the budget for the European contribution to the project (EUR 6.6 billion (in 2008 values)) and has encouraged F4E to pursue with vigour all cost containment actions which are under its direct control. The GB has also emphasised that cost containment by the ITER IO is vital and has encouraged the European Commission to support F4E in this regard.

The Director of F4E, Professor Henrik Bindslev, resigned at the end of November to accept a new position as Dean of the Faculty of Engineering Science at the University of Southern Denmark. The GB expressed its thanks to Professor Bindslev for bringing a new energy to the project and for his dedication. The GB appointed Pietro Barabaschi, previously Head of the Broader Approach Department, as Acting Director.

In response to a request by the European Council, a team of independent experts carried out an annual assessment of F4E. This was the third such assessment and the report was submitted to the European Council as part of the regular scrutiny it conducts of F4E. The assessment also made a number of recommendations to improve F4E's effectiveness, for example to provide additional effort for inspections at contractor's premises, which the Director is acting on.

I would like to thank the members of the Governing Board for their advice and encouragement throughout the year as well as the members of the subsidiary bodies of the Board: the Bureau, Administration and Finance Committee (AFC), the Executive Committee (ExCo), Technical Advisory Panel (TAP) and Audit Committee (AC). I would like to thank the respective Chairs Lisbeth Grønberg (ExCo), Cor Katerberg (AFC), Joaquín Sánchez (TAP) and particularly to thank Beatrix Vierkorn-Rudolph who chaired the AC since 2011, but who has now stood down as a member of the Board.

I would also like to acknowledge the collaboration and support that I received from the European Commission, in particular from the Director-General for Research and Innovation, Robert Jan-Smits, András Siegler, the Director of Energy responsible for ITER and F4E matters, Andrea Carignani di Novoli, Head of the ITER section and the staff in their services.

None of F4E's achievements would have been possible without the contribution of its staff. On behalf of the Board, I would like to offer them our warm support and thanks for their skill, dedication and professionalism.

Mr Stuart Ward
Chair of the F4E Governing Board
26 May 2015

Foreword by the Director of F4E

In this Annual Report I am pleased to share with you how Fusion for Energy (F4E) has continued to deliver Europe's contributions to the international ITER and Broader Approach fusion energy projects. In the early stages of projects such as ITER much design, development and research work needs to be carried out "behind the scenes", but every year we are seeing more and more visible evidence of progress including at the ITER construction site in Cadarache.

Important milestones have been achieved in a number of areas in 2014 that testify to the strength of the partnership between F4E, the ITER Organization and European industries. One of those milestones was the completion of the foundation slab of the building that will house the ITER device. This 14,000 m^3 concrete slab contains 4,000 tons of iron reinforcement bars. Elsewhere on the ITER site, the foundations of the Assembly Building were completed and the first parts of the 60 metres high metallic structure of the building were erected.

Moving to the magnets that will hold the hot plasma in ITER, good progress has been achieved. F4E has completed the production of 97 tons of superconducting cable for the Toroidal Field (TF) magnets. Many of the main components for the TF magnets have entered into series production and the first prototype double layer winding of superconducting cable, the so-called Double Pancake, was fabricated. Radial plates, metallic structures holding the wound superconductors in place in the face of the strong and dynamic magnetic forces they will be exposed to in ITER, are being manufactured (one every 13 days) with an excellent control of the dimensional tolerances (some tens of parts per million over the 700 metres conductor length). This accuracy in manufacturing ensures that the wound superconductors slot into place in the radial plates without forcing, despite accelerated production procedure.

Work continues on the fabrication of the 500 ton sectors of ITER's vacuum vessel and fabrication of the first one has commenced while more that 60% of the required raw material has been sourced. In 2014 there has also been progress in the pre-qualification of the components being developed by F4E to protect the inside of the vacuum vessel from the hot plasma – the first-wall and divertor. Thanks to successful tests under intense heat, F4E and its industrial partners have now entered the second stage of the pre-qualification process for the first wall panels. In parallel, heat testing of mock-ups of the divertor targets has also provided promising results.

In order to achieve fusion, the plasma in ITER must be brought to high temperatures and F4E is heavily involved in the development of several heating systems. For the radio- and microwave heating systems much of this work is in the research, design and development stage but there are promising results. In particular, there have been promising experiments with a short-pulse gyrotron in late 2014 where a power of over 1 MW of 170 GHz microwaves was produced, meeting the ITER requirements except for the pulse duration. For the neutral beam heating systems, the construction of a new testing facility in Italy continued apace with the buildings almost completed and major components under manufacture.

Development of remote maintenance systems for ITER is an important area of F4E's work for which design, development and testing work is underway. One of the highlights of 2014 was the carrying out of the first full divertor cassette installation and removal sequence under conditions similar to those in ITER. Another important contribution of F4E is the LN2 cryoplant, the most complex and compact large-scale refrigeration system in the world, and in 2014 F4E completed the preliminary design of the LN2 Plant and Auxiliary Systems, first phase of a contract awarded to a leading European industry. For the ITER diagnostic systems, F4E now has eight partnership agreements with European research laboratories for the development of detailed designs. Last but not least, steady progress was made in the development of the Test Blanket Modules.

In spite of the impressive progress achieved in 2014, I have to acknowledge that the ITER project is behind schedule. The requirements and design of ITER is still evolving which does affect the rate of progress on construction and manufacture. In 2014 we found that the time required for the finalisation of the design and construction of the buildings and manufacture of some other major components was longer than foreseen. It is widely recognised that the present ITER schedule does not adequately take into account the technical and organisational complexity of this unprecedented project and the ITER Council has requested a revised schedule by June 2015.

To deliver on our commitments, in 2014 F4E awarded 61 operational contracts and 7 grants to industries, laboratories and other organisations for a total value of just over EUR 400 million bringing the total value of contracts and grants awarded to EUR 3.248 billion. At the same time, 86 new procurement or grant procedures were launched.

Moving to the Broader Approach (BA), I am pleased to report that good progress was made during 2014 and that the overall level of progress measured by a comparison of earned and planned credit remained at 90%. For the Satellite Tokamak Programme (JT-60SA project) the production of the TF coils progressed well following the resolution of an issue with the originally supplied forged material for the coil casings. The assembly in Japan advanced with the welding of the vacuum vessel.

For the BA IFMIF/EVEDA project, the testing of the LIPAc (Linear IFMIF Prototype Accelerator) injector was completed and allowed the start of commissioning with a first plasma formed in the ionization chamber in October 2014. Diagnostic components were shipped to Rokkasho where the experiment is being assembled.

For the BA IFERC project, the third cycle of projects using the Helios supercomputer was completed and the usage of the facility remained high (around 90%), and availability above 98%. In September a successful bi-annual Joint Workshop for DEMO Design and DEMO materials was held in Barcelona. Work started on the analysis of dust from JET at the IFERC site in Rokkasho, Japan.

Cost containment continues to be a high priority for F4E to ensure that F4E remains within the capped budget to 2020. As mentioned earlier, the schedule for ITER construction is being revised at the request of the ITER Council and during 2014 F4E continued to work closely with the ITER Organization to review and adjust the schedules for work under F4E's responsibility to ensure that they are realistic and commensurate with the available human resources.

During 2014 F4E continued to deepen its engagement with industry and European Fusion Laboratories (EFLs). In particular, a new set of model contracts were developed in line with F4E's Industrial Policy and the final pieces were put in place to allow the implementation of lump sum grants in line with F4E's action plan for EFLs. In relation to the wider public, F4E engaged in a number of communication activities in 2014 including a major media event at the ITER site in May. F4E also increased its coverage in conventional and social media channels, in particular, YouTube where viewings doubled compared to 2013.

In relation to F4E's internal functioning, an important development in 2014 has been the creation of a Planning and Monitoring Unit reporting to the Director which merges and reinforces functions which were previously located in different parts of F4E. This new Unit is, among other things, responsible for the overall process of establishing and maintaining cost and schedule baselines including management of their changes. It is also responsible for the continued development of reporting systems, including Earned Value Management. I am pleased that the reporting systems are being widely used by staff and with increased frequency.

In 2014 F4E implemented a budget of just under EUR 900 million in commitment appropriations and EUR 502 million in payment appropriations, corresponding to 100% and 89% of the final budgets. However, it should be pointed out that during the course of 2014 the payments budgets was already reduced by 21% compared to the initial budget due to the fact that some contracts were not implemented at the rate originally envisioned. At the same time F4E has continued to recruit personnel throughout 2014 and by the end of the year there were almost 393 staff in post and the vacancy rate fell to 5.3%.

This is my last Annual Report as Director of F4E since I am leaving the organisation at the end of February 2015 to take up a new position as Dean of the Engineering Faculty at the University of Southern Denmark and return to my family. I would therefore like to take this opportunity to express my gratitude to managers and staff at F4E who continue to work with dedication and diligence under challenging conditionals. My time at the helm of F4E has been most engaging and one of the highpoints of my professional career.

I would also like to take the opportunity to thank Mr Stuart Ward, Chair of the F4E Governing Board as well as the members of the Board and the other supervisory committees for the confidence they have placed in me over the last two years. I have also appreciated the effective cooperation between F4E and the European Commission for which I would like to thank the Director-General for Research and Innovation and European Representative at the ITER Council, Mr Robert-Jan Smits and his services, in particular, András Siegler, the Director of Energy and Mr Andrea Carignani di Novoli, Head of Unit for ITER.

To conclude this foreword I would like to underline my conviction that fusion, as a practically unlimited and environmentally sound source of energy, has the potential to make an enormous contribution to our sustainable development from the second half of this century. ITER is the next essential step for the realisation of fusion energy as well as an important scientific and technologic endeavour that undoubtedly will provide many beneficial spin-outs. ITER is a high-risk high-gain investment of some magnitude with the potential to dramatically change the energy economy and facilitate its global sustainable development. It can also play a central role in the energy security of Europe and other energy importing regions. To put perspective on these reflections let me share with you the observation that Europe is spending more than EUR 7 billion per week to import energy to meet its needs, more than the entire European funding for the ITER project.

Professor Henrik Bindslev
Former Director of Fusion for Energy
20 April 2015

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 International Organization – ITER IO) 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 21 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?

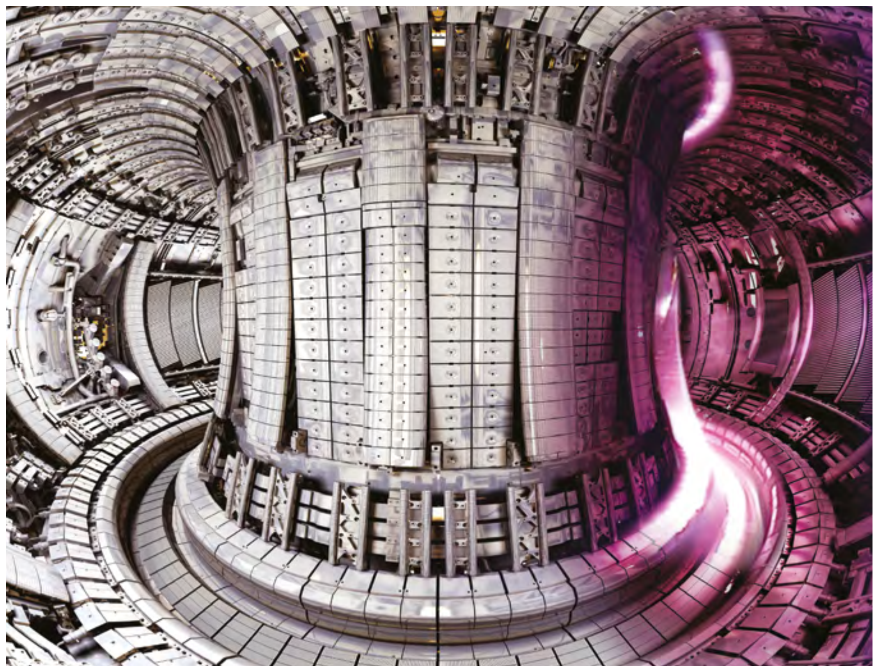
Fusion is the process that powers the sun and other stars and makes life on Earth possible. As the name suggests, the process involves fusing together light atoms to make heavier ones and occurs at the extreme pressures and temperatures caused by the gravity in the sun. During fusion reactions a small 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 EUROfusion.



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 EFDA-JET)

What is ITER?

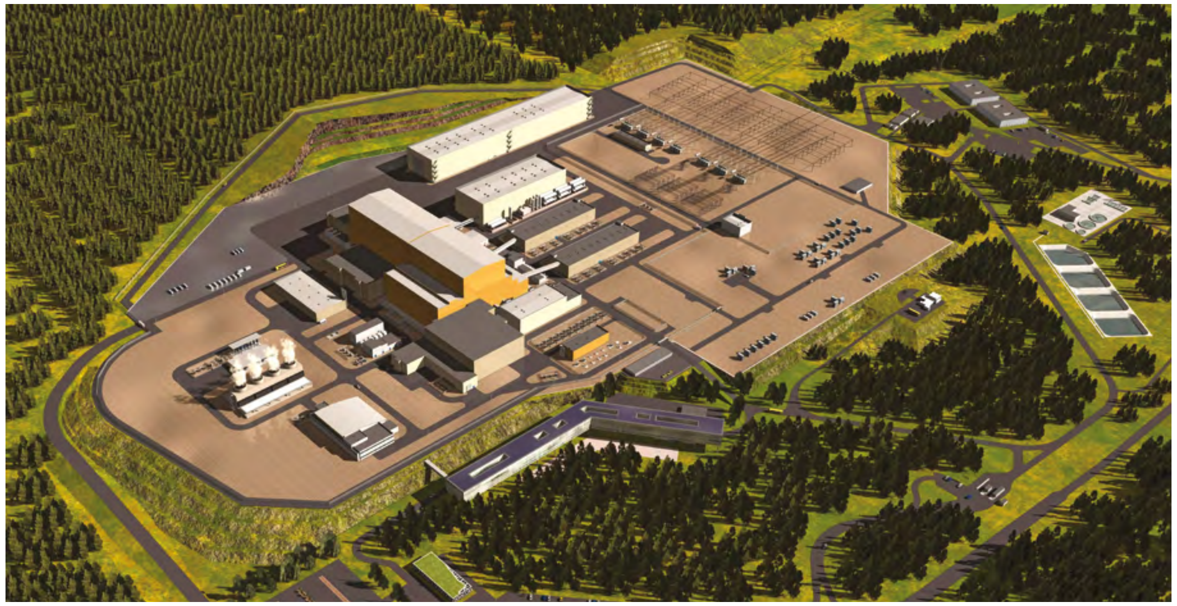
While JET and other tokamak experiments have succeeded in producing significant amounts of fusion power for short periods, none so far are capable of demonstrating fusion on a scale that would be needed for a reactor and a number of technologies that are needed to allow it to generate part of its own 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 IO is responsible for the construction, operation, exploitation and decommissioning of the ITER device. The Director General of the ITER IO is appointed by the ITER Council which also supervises the overall activities of the ITER IO. 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. This 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.

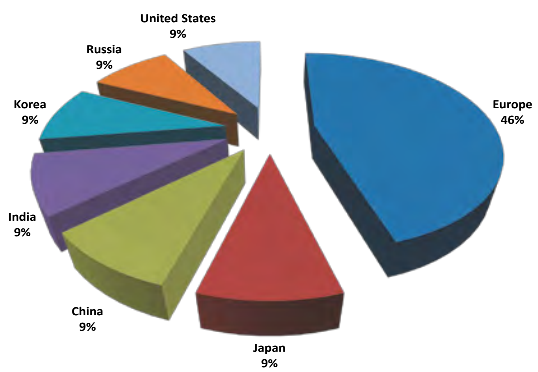
F4E is the European Domestic Agency (DA) for ITER and provides, on behalf of Europe, components to ITER that amount to five-elevenths (see pie chart) of the overall value of the project.

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:

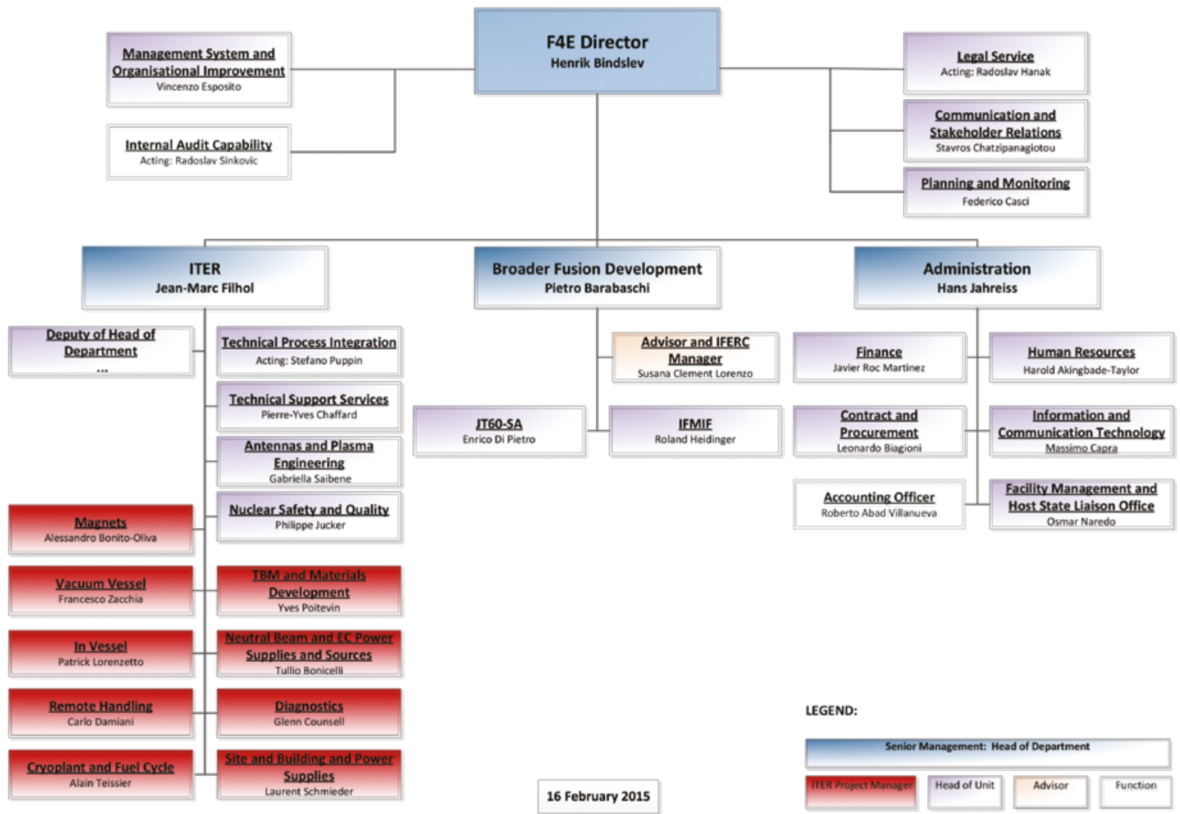
- If there is research, design, prototyping or other preparatory work to be done before an ITER component can be manufactured, ITER may issue a request known as an ITER task agreement (ITA) to DAs (including F4E) to do the work.
- On the basis of the specifications in the ITA, F4E contracts out work (usually to European fusion laboratories) 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 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.



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

Our Organisation



Director and Senior Management Team (on 1 March 2015)

Pietro Barabaschi

Pietro Barabaschi, an Italian national, has been Acting Director of F4E since 1 March 2015, 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 1 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 1 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.

Director (until 28 February 2015)

Henrik Bindslev

Henrik Bindslev, a Danish national, was Director of F4E from 1 January 2013 until 28 February 2015. A physicist with a DPhil in Plasma Physics, Professor Bindslev has been engaged in energy research for more than 20 years with experience in research management, both in Denmark and internationally. Before taking up the post as Director of F4E, Professor Bindslev was Vice Dean for research at Aarhus University, Faculty of Science and Technology and past Chair of the European Energy Research Alliance (EERA). Previously, he was the Director of Risø DTU, the Danish National Laboratory for Sustainable Energy.

Chapter 2

Our Achievements

ITER

Introduction

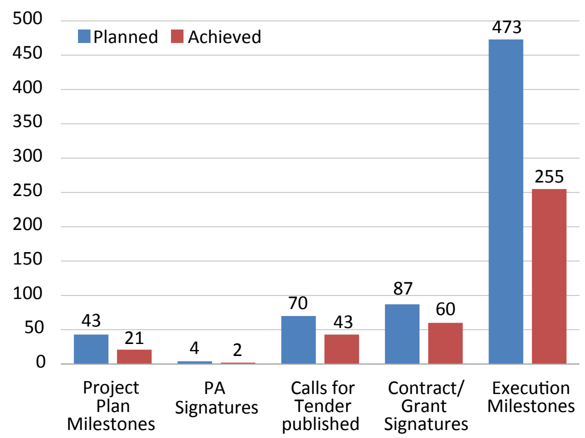
All F4E activities in 2014 were carried out according to the approved Work Programme 2014 and the amendments adopted by the Governing Board.

The F4E Detailed Work Schedule (DWS) contains the planning of the operational activities to be carried out by taking into account the delays accumulated during the execution of the contracts. The DWS is submitted on a monthly basis to the ITER Organization and 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. During 2014 F4E was requested to critically review its activities in order to provide a more realistic timing for their execution. The same was requested to all DAs and this input will lead to a proposal for a reviewed project schedule to be submitted for approval to the ITER Council in 2015.

In 2014 F4E signed a significant number of procurement arrangements (PAs) and contracts (see annexes). Two Procurement Arrangements for a total value of 8.2 kIUA (approximately EUR 14 million) were signed in 2014. In addition, two non-credited PAs on Test Blanket Modules (i.e. Helium Cooled Lithium-Lead and Helium Cooled Pebble Bed) were signed. The integrated value of the PAs signed by the end of the year reached approx. 950 kIUA.

Key Performance Indicators

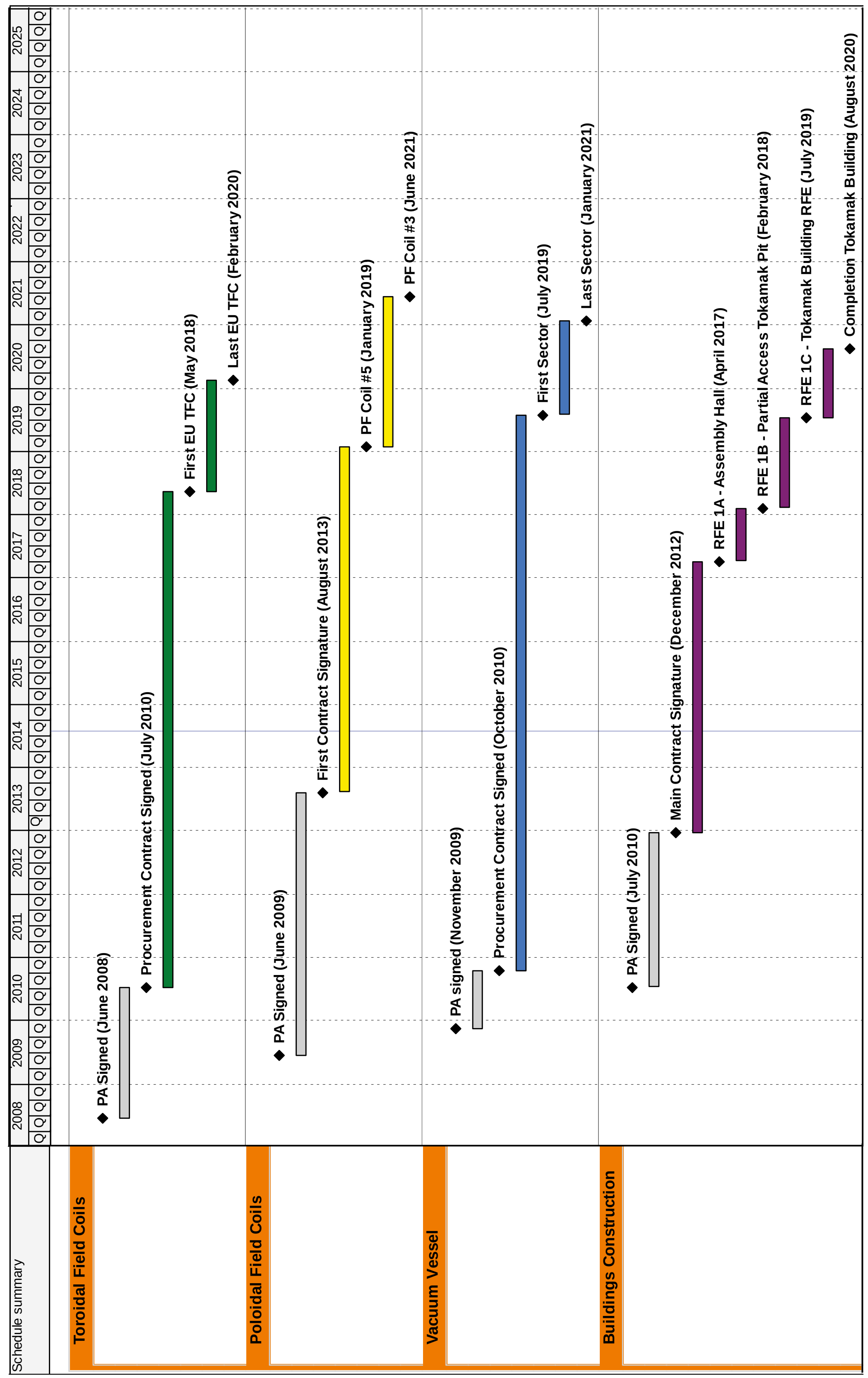
To quantitatively assess the progress made by F4E, a number of Key Performance Indicators (KPIs) are used: Project Plan Milestones, PA signatures, Calls for Tender published, Contract Signatures, and Contract Execution Milestones. A comparison of the planned and achieved milestones by the end of 2014 for the above KPIs is shown below.

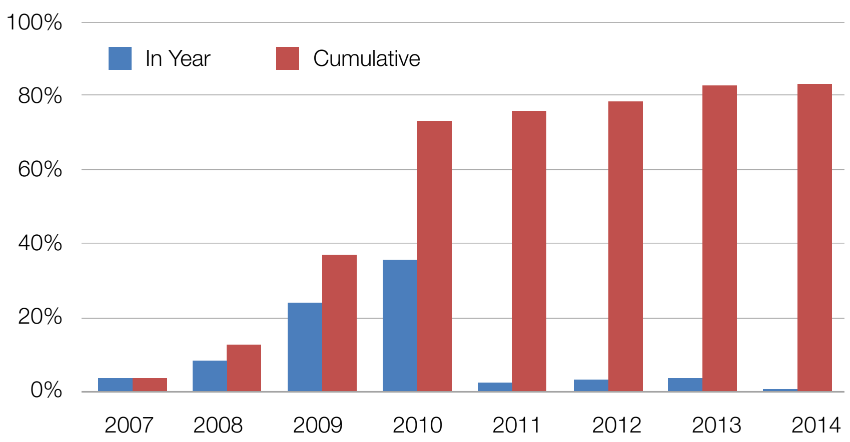


	Milestones		
	Planned	**Achieved**	**Achieved Planned**
Project Plan	43	21	49%
PA Signature	4	2	
Call for Tender	70	43	61%
Contract Signature	87	60	69%
Contract Execution	473	255	54%

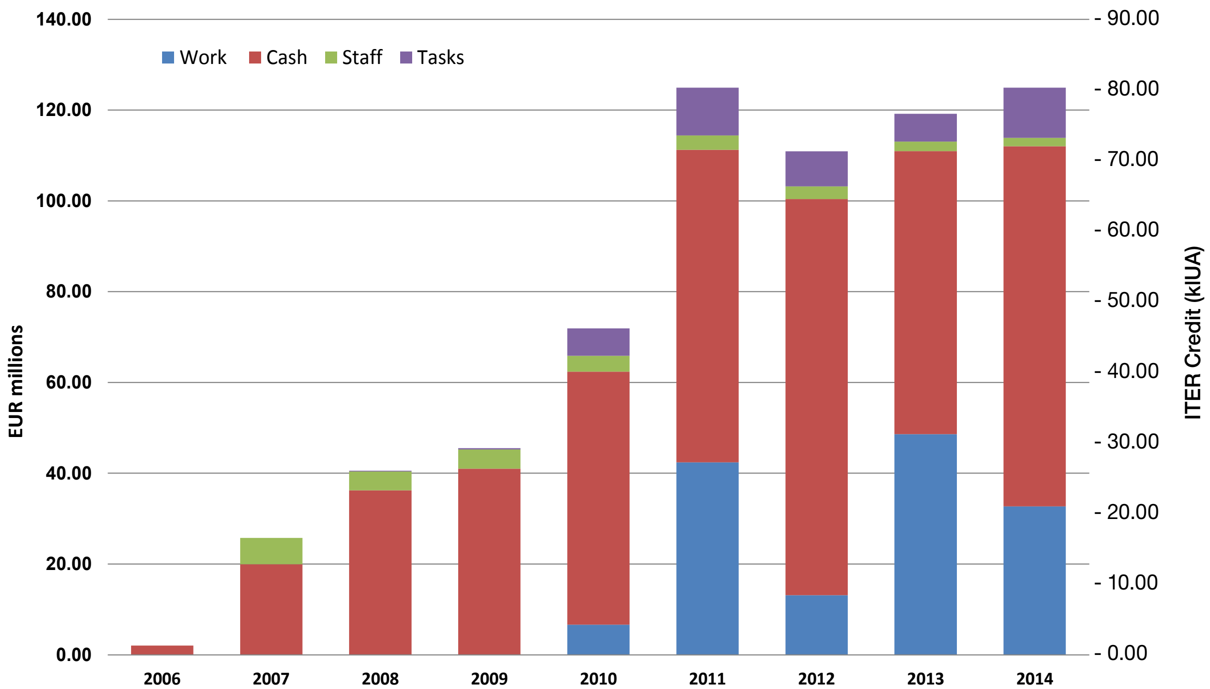
Status of Key Performance Indicators until the end of December 2014

Overall Schedule for the European In-Kind Contributions to ITER





ITER Procurement Arrangements (% of total concluded in value)



Credit awarded to F4E by ITER (in EUR million) where "Work" is the credit awarded for work completed by F4E under Procurement Arrangements, "Cash" are cash contributions, "Staff" are staff contributions are "Tasks" are activities performed under Task Agreements.

Risk Management

Risk Management at F4E currently consists of two different levels: corporate and project level. The project risk management implementation started in 2011 and will continue in the following years, while the corporate risk management was implemented in the second part of 2012, and has be updated and monitored since then.

As far as the EU in-kind procurements are concerned, risk analysis has progressed through in-house analysis and feedback from the suppliers (whenever a manufacturing contract was in place). The analysis has concentrated on the components on the critical path. During 2014 the analysis has been extended to 28 Procurement Arrangements, with the aim to extend the analysis to all EU Procurement Arrangements

Following the F4E risk management process, the following probability/impact matrix (PID matrix) has been used for the risk level ranking in order to define the priorities of the risk events.

PID Matrix		Impact				
		Very Low	Low	Medium	High	Very High
Probability	Very Likely	5	20	45	80	125
	Likely	4	16	36	64	100
	Not Likely	3	12	27	48	75
	Unlikely	2	8	18	32	50
	Not Credible	1	4	9	16	25

Level	Actions
VERY LOW	They are included in the risk file and reviewed by Technical Project Officer (TPO) concerned. Actions are evaluated in order to reduce the risk.
LOW	They are included in the risk file and reviewed by TPO concerned. Actions are evaluated in order to reduce the risk.
MEDIUM	An owner is appointed to monitor the risk evolution and report to the TPO concerned. Actions are evaluated in order to reduce the risk.
HIGH	Same as level MEDIUM plus definition of specific mitigation actions. These actions are defined by the TPO concerned with the risk, which identifies also possible trigger events to start them. The owner monitors the risks and these trigger events.
VERY HIGH	Planned mitigation actions are started as scheduled. The risk owner is designated directly by the Project Manager, who closely monitors the effectiveness of the mitigation actions at each project review meeting

Most of the events categorized as High and Very High have a mitigation plan that reduces the expected residual risk to an acceptable level.

Project Management and Scheduling Activities

In 2014 the F4E Planning & Monitoring Unit has kept on providing an extensive transversal support to other F4E Units. The areas involved with this work were: 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 WBS Schedules (DWS) have been regularly updated and submitted to the ITER Organization at the beginning of each month to allow the organisation 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 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 committees for their review and approval.

Work on export control has progressed. Support was provided to the ITER Project Teams to identify and to deal with dual use items. Regular contacts have taken place with the Spanish Authorities on this topic.

Project Management support was provided on several topics linked to the day-by-day activities, such as the preparation of the Procurement Arrangements and the management of the Task Agreements with the ITER Organization. Programmatic documents have been prepared to be presented to the supervising committees as well as regular reports to show the progress in the implementation of the work. Cash contributions to both the ITER Organization 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 being used at F4E are being continuously improved. A formal change control procedure was implemented which will allow such unplanned milestones to be taken into account. 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.

Site, Buildings and Power Supplies

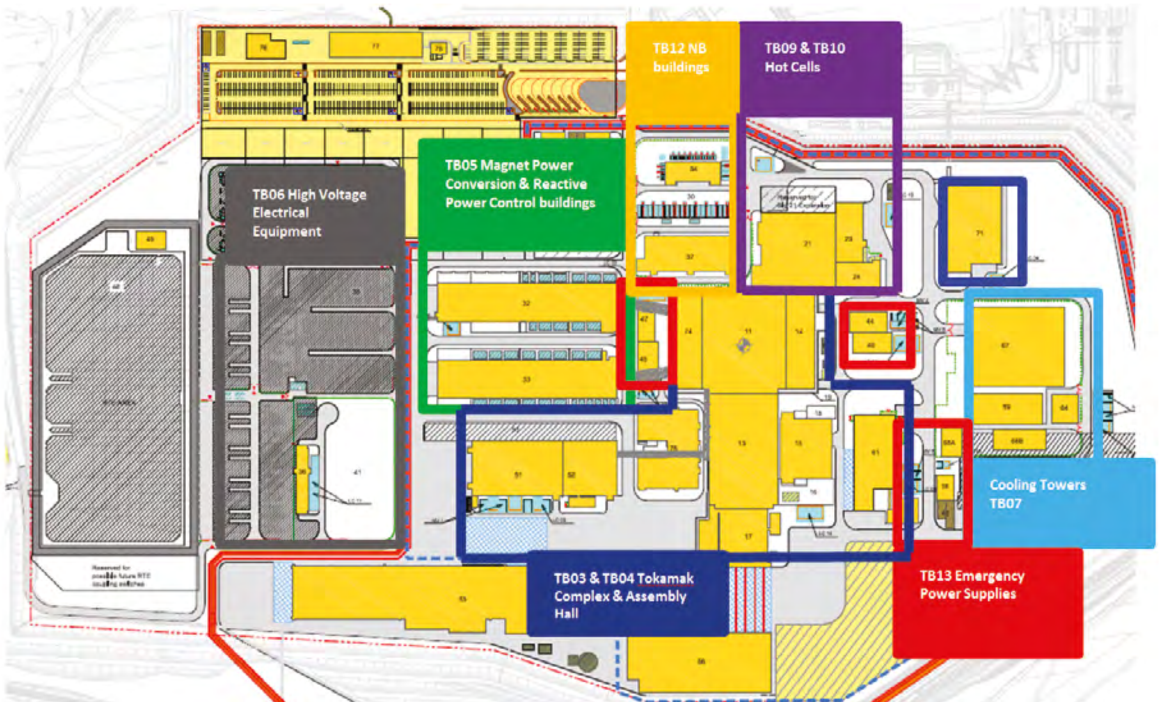
F4E is responsible for the in-kind procurement of the site infrastructure and all concrete and steel frame buildings and power supplies through the following Procurement Arrangements with the ITER Organisation:

- Poloidal Field coil winding facility (12.8 kIUA);
- Architecture engineering services (55.8 kIUA);
- Tokamak excavation (31 kIUA);
- Supply of anti-seismic bearings for Tokamak Complex (6.2 kIUA);
- Building construction (346.1 kIUA);
- Office buildings (13.85 kIUA);
- Power supplies — pulsed power and steady state power supplies (45.2 kIUA).

Executive Summary

In the area of site, buildings and power supplies, the main highlights during 2014 are as follows:

- The B2 slab hold point was released by ASN (Autorité de sûreté nucléaire) on 10 July 2014 after an in-depth analysis of the robustness of the design, which allowed construction to start immediately;
- OPE-095 (TB00 - Construction of the Tokamak Complex Seismic Isolation Pit, Supply and Installation of Anti-Seismic Bearings): pouring of 14,000 m^3 of reinforced concrete (1.5 metre thick slab 120 m x 80 m) and completion of the works the B2 slab;
- OPE-406 (TB Alpha - Galleries and drainage works) and OPE 251 (TB01 - Site Adaptations Works): the works were finalised;
- OPE-285 (TB02 - Cask Transfer Lift & Tokamak Cranes): Final Design Review for cranes and Cargo lift was approved;
- OPE-286 (TB03 - Main Civil works & Finishing works for Tokamak complex, Assembly Hall and surrounding buildings):
    - o Works in the Assembly Building B13, Services building B61 and on Tokamak walls level B2 has started;
    - o Construction Design Review for most of the TB03 steel frame buildings has started.
- OPE-301 (TB04 - Main Mechanical, HVAC, Electrical and Handling Equipment supply and installation for Tokamak complex, Assembly Hall and surrounding buildings):
    - o Basis of Design documents are accepted;
    - o An achievable and approved technical solution was found for PCR 412 (Implementation of safety requirements in the Tritium building) to minimise possible delays;
    - o Detailed Design of several buildings has started with Services building B61.
- OPE-378 (TB05 - Design & Build for Magnet Power Conversion buildings 32-33 and Reactive Power Control Building 38) and OPE-429 (TB07 - Design & Build for Cold Basin & Cooling Towers (67), Pumping stations (68) and Heat exchangers (69): Final Design Review was finalised;
- OPE-428 (TB06 - HV Electrical Equipment): the contract was signed in December 2014;
- OPE-374 (TB08 - Site Infrastructure Works): the contract was terminated after the construction design phase;
- OPE-540 (TB13 - Emergency Electrical Power Distribution): call for expression of interest to supply the Emergency Electrical Power Distribution equipment is launched;
- Works related to the Agreement on Site Preparation between Agence ITER France (AIF) and F4E are completed.



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

Work Progress

During the year the following works on the construction site were conducted:

- **OPE-095 (TB00):** The first floor slab of the Tokamak Complex was completed on 27 August 2014.

This landmark achievement marks the conclusion of the foundation works started in August 2010. It represents an investment of around EUR 100 million for F4E. Following the release by the French Nuclear Authority (ASN - Autorité de sûreté nucléaire) on 10 July 2014 of the first Hold Point of the building concerning the justification of the robustness of the building design, nine central sections of the slab were poured within seven weeks leading to a successful completion of the works in late August 2014. In total 150 workers were involved in this operation, using 14,000 m^3 of concrete, 3,600 tons of steel and 2,500 embedded plates. Construction has been carried out by a group of companies led by GTM SUD and under the supervision of F4E and the architect engineer ENGAGE.

The basemat has a surface of 9,600 m^2 and a thickness of 1,5 m of reinforced concrete consisting of four successive layers – two of 50 cm, one of 30 cm and one of 20 cm. The first of the fifteen plots of concrete was poured in December 2013.

- **OPE-251 and OPE-406:** Critical networks allowing the operation of precipitation drainage for worksite activities OPE-251 (TB01) and galleries at the vicinity of the Tokamak complex OPE-406 (TBALPHA) in anticipation of OPE-286 works on the tokamak are completed. The goal of the Site, Buildings and Power Supplies (SBPS) team – to advance these galleries, not to affect the critical path of OPE-286 (TB03) activities – is satisfactorily reached. The construction of the temporary road network, infirmary and restaurant is also completed making it possible for contractors to set up their company offices on the site.

- **OPE-286 (TB03):** First concrete was poured by TB03 contractor in the Tokamak Complex (first wall in B2 level of the Diagnostic building).

Completion of the first floor slab of the Tokamak Complex

With the B2 slab basemat now completed, the construction of the complex that will house the core buildings of the machine has started. 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 are responsible for carrying out the works (TB03). The building will be 80 metres tall, 120 metres long and 80 metres wide. It will require 16,000 tons of steel reinforcement bars and 150,000 m^3 of concrete.

Construction works started at the Assembly Hall building, where the massive ITER components will be put together. The steel structure of the building has become visible and the first columns have been erected. They weigh more than 15 tons each and are 12 metres high (once fully erected the building will be 60 metres high).

Construction works of building 61 "site services buildings" have started: excavation and galleries below the building have been performed.

- **OPE-301 (TB04):** Review of Basis of Design documents (349 documents/10 system packages) has formally started on 10 June 2014 and closed on 30 October 2014. Approximately 180 engineers of the contractor (Omega Consortium) were working to deliver these documents for F4E review. On 2 December 2014 the final design review for building 61 started.

- **OPE-285 (TB02):** Final Design Reviews were completed for the two 750 ton cranes for the Tokamak Assembly Hall and the 120 ton capacity Tokamak Cargo Lift for the NKM contractor.

- **PA06 Construction of ITER Headquarters' building:** Completed within the budget (EUR 65 million) according to the obligations towards AIF according to the Agreement on Site Preparation signed by the European Commission in 2007 and later on transferred to F4E.

Galleries in the vicinity of the Tokamak Complex

Galleries in the vicinity of the Tokamak Complex

Start of steel works at the Assembly Hall building

The Assembly Hall building, December 2014

Procurement Activities

Despite the unexpected changes in the agreed scope, during 2014 F4E's SBPS team managed to implement those changes within the existing contracts. In addition, the difficulties encountered with TB08 contractor obliged F4E to refine the procurement strategy. The TB08 contract has been terminated and the remaining works of TB08, as well as the scope of TB14 and TB15, have been merged into the new TB16.

Several procurement procedures were managed in 2014 in parallel for the following Tender Batches (TBs):

- **OPE-428 (TB06)** HV Electrical Equipment (contract signed on 14 December 2014).

The scope of this contract includes the design, partial supply, installation, commissioning and maintenance of the High Voltage sections of ITER Steady State Electrical Network (SSEN) that will supply the electricity needed to operate the entire plant, including offices and the operational facilities) and the Pulsed Power Electrical Network (PPEN) that will be used during plasma operation to provide power to the superconducting magnet coils and the heating and current drive systems. The High Voltage components for SSEN are delivered by the US Domestic Agency while the PPEN ones are delivered by the Chinese Domestic Agency. Medium Voltage Load Centers, cables and cables trays are also in the scope of the contract as well as part of the civil and technical works for the supporting buildings.

- **OPE-540 (TB13)** Call for expression of interest was launched on 20 November 2014.

The scope of this contract includes the detailed and construction design, construction/manufacturing and installation, testing, commissioning and maintenance of nuclear qualified Protection Important Components (PIC), electrical distribution equipment and buildings.

- **OPE-636 (TB16)** Call for expression of interest was launched in December 2014.

The scope of this contract is 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.

All the mentioned activities were supported by F4E's supporting contractors:

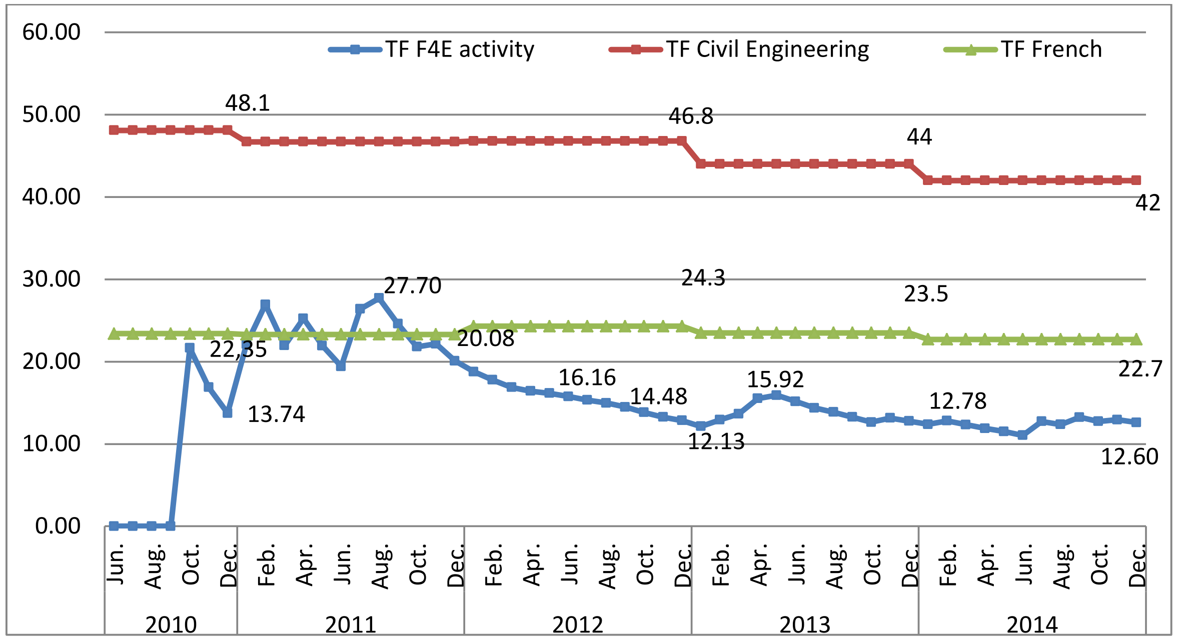
- Architect engineer (ENGAGE ~250 staff) - scope: studies, design, scheduling, evaluation of contractors, technical monitoring of construction contracts;
- Support to the owner (ENERGHIA ~30 staff) - scope: daily support to F4E in monitoring contracts (including the review of the design);
- Health, safety and legal inspection services (APAVE ~10 staff) - scope: compliance to health and safety requirements, to French and European construction norms, access to the site.

Development of construction design and construction supervision of works by the architect engineer is on-going. In 2014 the architect engineer issued 1,082 drawings, 148 calculation notes, 28 procedures and 701 other documents.

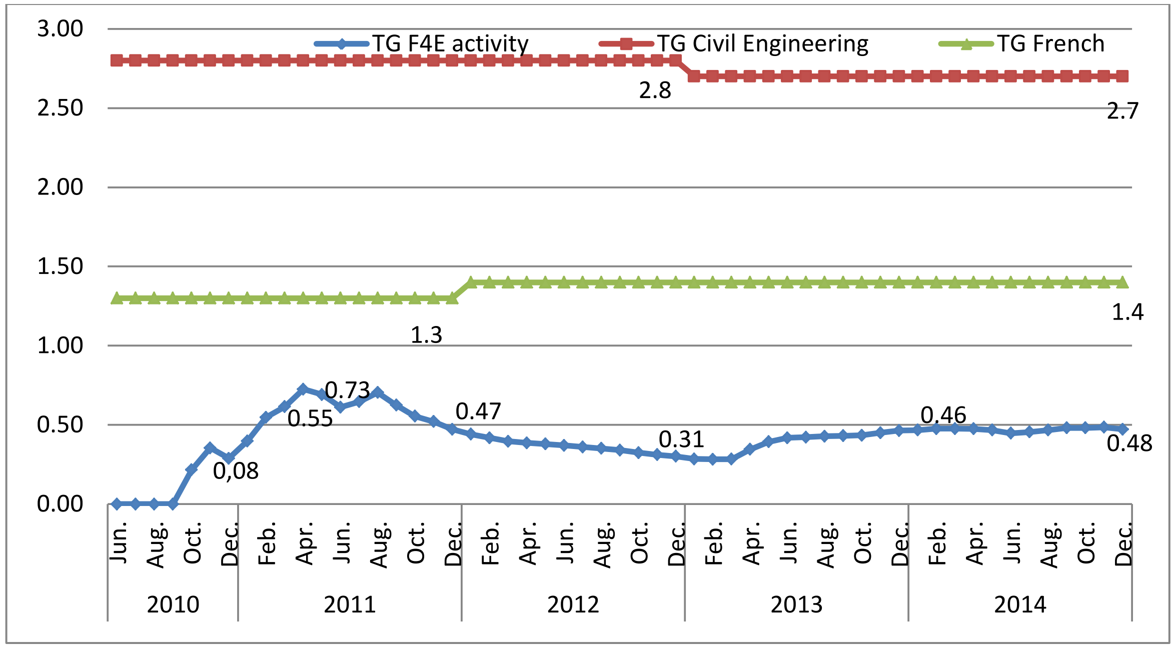
Health and Safety on the ITER Site

Health and safety management of the on-site activities at the ITER site is of paramount importance. During the year, around 597 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 ITER worksite in comparison with the data for French companies and civil engineering in general for the same period.

As demonstrated by the following graphs, since 2012 both the frequency and severity indicators for work on the ITER site have been consistently well below both of the average levels which are compared in the graphs above. 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)

Power Supplies

In 2014, the activities focused mainly on the preparation of the procurement process and the start of the implementation of contracts for the Pulsed Power Electrical Network and the Steady State Electrical Network, in particular:

- Progress on the tendering process of TB06 and TB13 involving power supply activities (finalisation of tender documentation, launch of Call for tender/ Expression of interest, award of TB06 important contract for the power supply);
- The TB06 contract for the Electrical Power Distribution has been awarded to Ferrovial Agroman S.A. in October 2014 and signed the 18 December 2014.
- The TB13 (Emergency Power Supply) pre-selection procedure has been launched at the end of November 2014;
- During 2014 the design of the Steady State Electrical Network most critical low voltage load centres started and progressed to a quite high level of details;
- By the end of the year several activities linked to the site preparation of the first electrical components delivered by the US Domestic Agency took place in a shared and fair collaboration with the ITER Organization.

Overall, the site, buildings and power supplies activities were implemented as foreseen in the 2014 Work Programme and in accordance with the Project Plan and ensuring the requested quality of works delivered on the construction site.

Risk Management

In the following an overview of the number of risk events, their levels and the evolution from 2012-2013 per procurement arrangement is provided.

- EU.01.41.01 – Electrical Power Distribution System → no relevant changes from risk point of view;
- EU.01.61 – Site and Buildings → for buildings the signature of TB04 and TB03 have closed some of the risks and decreased the risk level analysed last year. The move to a realistic schedule has decreased the current risk level. The late, incomplete and changing input date from the ITER Organization for buildings remains a major risk for the SBPS project in terms of schedule and cost.

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 2014 of which the highlights include:

Conductors

- Total production of 97.4 tons of Toroidal Field Nb_3Sn strand completed;
- Successful testing of TFEU11 and PFEU2 at the SULTAN test facility;
- Fabrication of three 760 m unit lengths , three 415 m unit lengths and a 100 m additional length of Toroidal Field conductors;
- Completion of the Poloidal Field conductor qualification phase;
- Fabrication of the following Poloidal Field conductors: two 400 m PF1 and two 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;
- Successful completion of the full-size superconductor Double Plancake (DP) prototype - this is the first TF coil full-size DP ever manufactured in the world;
- Series production of the 70 radial plates and of the 70 Double Pancakes well underway:
    - o Ten Radial Plates completed and delivered to the winding pack supplier;
    - o Winding of 20 DPs completed;
    - o Heat treatments of 15 DPs completed;
    - o Insertion of ten DPs completed;
    - o Turn Insulation of five DPs completed.

Poloidal Field Coils

- Start of the Winding Tooling Contract;
- Start of the Site and Infrastructure Contract;
- Launch of the Call for tender for the Impregnation and Additional Tooling Contract;
- Launch of the Call for tender for the Manufacture and Cold Test Contract.

Pre-Compression Rings

- Unsuccessful test of second 1/5 scale qualification ring;
- Analysed results and understood causes;
- Redefined qualification strategy with the ITER Organization. Qualification activities start on February 2015.

Progress Report on the Conductors

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

- The full supply of more than 97 tons of Nb_3Sn strand for the Toroidal Field conductor has been completed in 2014 through the two strand contracts (F4E-OPE-005-01 and F4E-OPE-005-02). Altogether more than ten tons of superconducting strands have been delivered to the cabling supplier and approved by F4E in 2014;

- The contract for the characterisation of Toroidal Field Nb_3Sn strand samples (F4E-OPE-145) is progressing very well and has already provided the verification tests needed for the ATPP clearance of the total amount of strand production units (billets) for both the F4E-OPE-005-01 and F4E-OPE-005-02 contracts;

- The SULTAN test of the Production Phase F4E Toroidal Field conductor lengths (TFEU11) was successfully completed at CRPP, thus confirming the adequate and regular performance of the F4E Toroidal Field conductor lengths made with the F4E-OPE-005-01 superconducting strand. The SULTAN test of the Qualification Phase for F4E's Poloidal Field (PFEU2) has been successfully completed at CRPP, thus confirming the suitability of the PF6/PF1 conductors for the ITER PF6/PF1 coils;

- The contract for cabling and jacketing of the Toroidal Field and Poloidal Field conductors, as well as the JT-60SA conductor is proceeding well with already around 35 km of conductor fabricated for the three conductor types. In particular in 2014, around 7 km of the JT-60SA conductor, almost 4 km of the Toroidal Field conductor and more than 2 km of the Poloidal Field conductor have been manufactured by the supplier. For the Poloidal Field conductor, the qualification phase has been completed including the challenging jacket section Non Destructive Testing procedure qualification;

Final inspection on the Nb_3Sn strand with an Eddy Current Test (courtesy of Bruker EAS GmbH)

The second PF6 Poloidal Field production conductor length at the end of its spooling

Machining of two radial plates by CNIM (courtesy of CSC)

In the background a radial plate is being flipped at SIMIC. In the foreground a pre-machined side radial plate waiting to be transferred to the portal machine for the final machining (courtesy of CSC).

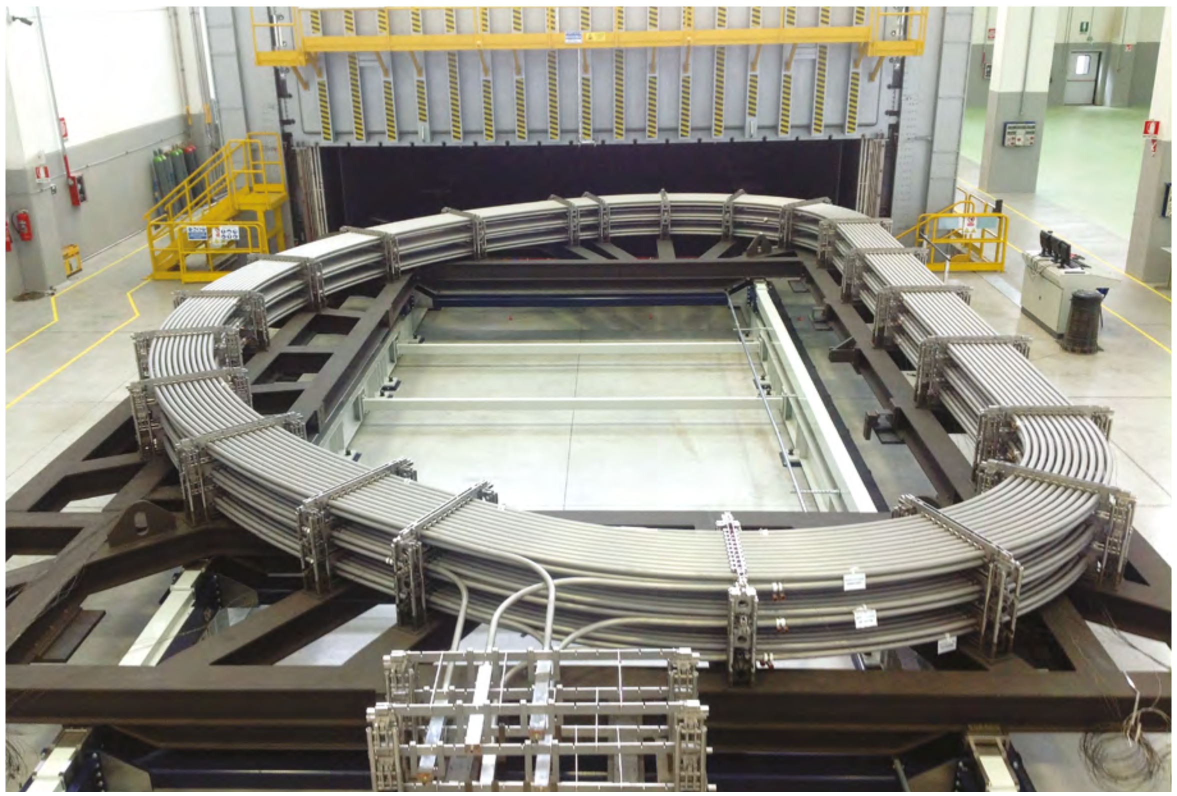
Progress Report on the Toroidal Field Coils

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, F4E-OPE-355) and related activities. This included:
  - 210 segments (FAV) delivered to SIMIC;
  - 168 segments (THYSSEN) delivered to CNIM;
  - Successful completion and delivery of 10 radial plates. Five have been produced by CNIM and 5 by SIMIC;
  - Accuracies obtained so far are very good, in particular considering the dimension of the radial plates. Planarity of the order of 1 mm, profile accuracy of the order of +/-0.5 mm and tolerances on the position of the groove within 0.15 mm with respect to the external profile.

- Follow-up of the contract for manufacturing of ten Toroidal Field winding packs (signed in July 2010, F4E-OPE-053) and related activities. This included:
  - Successful completion of the superconducting full-size DP prototype. The DP successfully passed all the acceptance tests at room temperature, including dimensional, high voltage in air and in Paschen conditions and leak test. The DP was then cooled at liquid nitrogen temperature.
  - Successful completion of the winding of 20 series production DPs using so far EU internal Tin and Russian conductor. During the winding of such 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.

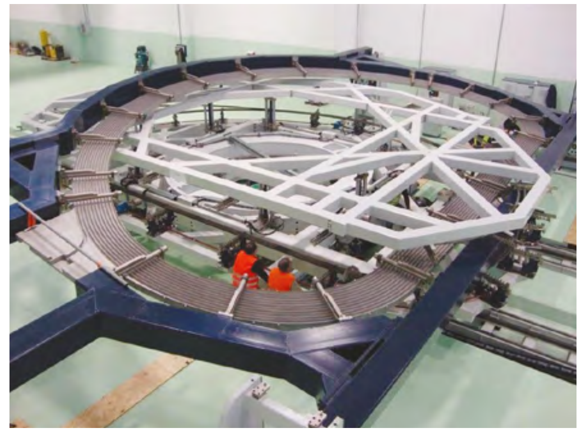
The EU superconducting full-size DP prototype with a part of the F4E and EU industry team during a collaboration meeting with the JA-DA team and with representatives of the Japanese industries involved in production of nine TF coils to be delivered by Japan (courtesy of CON)



Three series production DPs on their heat treatment frame being loaded inside the oven in ASG, La Spezia (courtesy of CON)

- o Successful completion of heat treatment of 15 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 10 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 five series production DPs.
- o Successful completion of cover plates on one series production radial plate with laser technology.

- Follow-up for the cold test and the winding packs insertion into the coil cases (F4E-OPE-414)
  - o Successful completion of the negotiation with a substantial cost saving compared to the initial bid;
  - o Signature of the contract in May with SIMIC, with BNG as main sub-supplier on winding pack cold test and TF coil gap filling;
  - o Defined with the supplier a horizontal insertion process, different from the ITER Organization proposed insertion in vertical 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;
  - o Closure welding and gap-filling qualification activities in progress.



Insertion of a DP inside the radial plate grooves in ASG, La Spezia. (courtesy of CON)

The three-turn insulation machines operating simultaneously on three different series production DPs (courtesy of CON)

The laser welding machine in operation during welding of cover plates on a side DP in ASG, La Spezia (Courtesy of CON)

Progress Report on the Poloidal Field Coils

A collaboration agreement was signed with the Chinese institute ASIPP for the manufacturing of the sixth Poloidal Field coil (PF6). In 2014, an extensive range of specifications, control plans and schedules were developed and accepted during the year for the qualification tooling, building modifications and the winding and impregnation tooling. Additionally a number of areas of the design have been developed into final concepts ready for implementation in the final drawings including; Helium Inlet, Joint Box and Tail design. The following pictures show some of the developments carried out at the ASIPP facility in Hefei, China and its suppliers – including:

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

- The engineering integrator contract (F4E-OPE-344), which started in August 2013, has moved forward significantly with the completion of the definition of the technical specifications for: impregnation and additional tooling, site and infrastructure, manufacturing and cold test and a large number of manufacturing procedures, as well as the completion of a number of areas of the design;

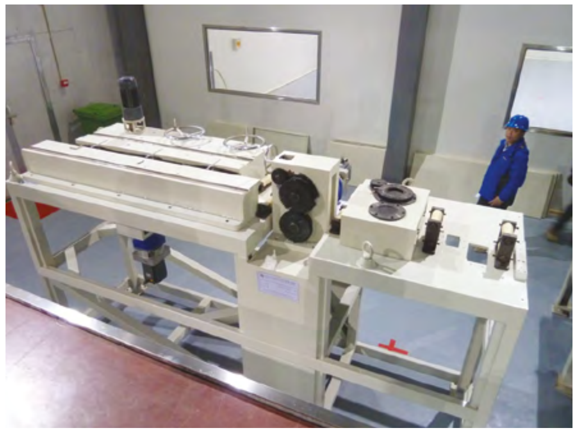
- The tender phase of the winding tooling contract (F4E-OPE-463) was completed and the contract signed in May 2014 with SeaAlp – an Italian consortium. Since the contract was signed significant progress has been made with both the conceptual and final design reviews being completed successfully as well as the start of procurement of all of the long lead-time components;

- Regarding the “Site & Infrastructure”, a market survey was completed in February 2014 and the specification completed before the Call for tender was launched at the end of May 2014. The bids were received and evaluation completed leading to the signing of the contract on 23 December 2014 with the Dalkia-Veolia consortium. The taking over of the building by Dalkia-Veolia is expected in February 2015;

- Regarding the additional tooling and impregnation tooling, the market survey was completed in January 2014 and the tender specification completed with the launch of the call for tender taking place at the end of September 2014 and the bids were received at the end of December 2014. The evaluation of the bids received is underway with the expectation that a contract will be signed in the Spring/Summer of 2015;

- Regarding the manufacture and cold test the market survey was completed in December 2014 and the specification completed before the call for tender was launched at the end of December 2014. Bids are expected in March 2015 with negotiations expected to be completed and the contract signed around the end of 2015;

- Regarding the remaining contract to be signed the Cold Test Facility contract the design study and accompanying specification were under development during the last quarter of 2014.



View of the Poloidal Field PF6 winding tooling line straightening unit – during commissioning at ASIPP

View of the poloidal field PF6 winding tooling line turntable– during commissioning

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. Analysed the causes and 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 tend to create wrinkles which strongly affect the quality of the ring. Therefore it has been established, also with the supplier and the ITER Organization, 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 the ITER Organization based on samples extracted from a full-size ring. In this way the properties of the samples will be fully representative of the full-size ring. The qualification of the full-size ring will start in February 2015.

Vacuum Vessel

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 (VV).

Following the signature in late 2010 of contract F4E/OPE/068 with AMW, an Italian consortium of suppliers, the first stages for the fabrication of the first three sectors were released and AMW has achieved in 2014 the progress as summarised hereafter.

Executive Summary

Progress and major achievements for 2014 were:

- The completion of manufacturing mock-ups to provide input on the manufacturing procedures, welding, assembly and inspection, model calibration and control of distortions.
- The finalisation of simulations on welding distortions of the segments for the welding sequence optimisation and achievement of the tight tolerances.
- The completion of the stress analyses related to the structural assessment of Sector 3. Results have shown a significant improvement and manufacturing optimisation.
- The finalisation of the AMW manufacturing strategy for Sector 5, including manufacturing 3D models, drawings and control plans for manufacturing.
- The completion of the In-Wall Shielding (IWS) blocks and ribs design for segment PS1 and 2 of sector 5. The IWS blocks are manufactured by the Indian Domestic Agency.
- The completion of the qualification of material suppliers for plates, forgings and filler material.
- The approval by all parties (F4E/IO/ANB) of the technical specifications for welding qualification for the different welding techniques.

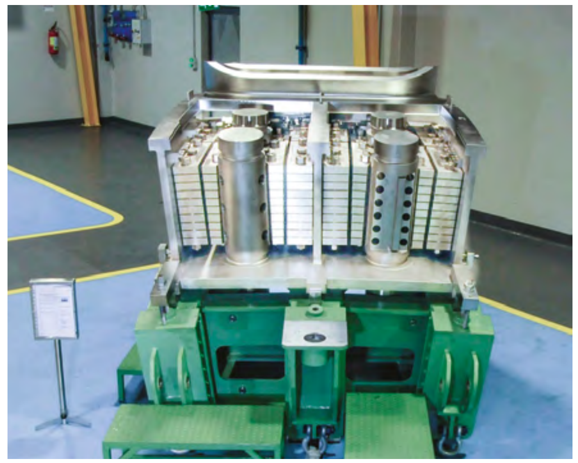
Progress Report

- Follow-up of the manufacturing contract for the vacuum vessel (VV), the largest component of the ITER device, involving manufacturing design, all required qualifications and the fabrication of 7 sectors;
- Definition of design, CAD activities and stress analysis to support design changes from the ITER IO and from F4E; Joint collaborative work of AMW-F4E-IO designers in Enovia using Teradici connection has facilitated approvals of Conceptual and Detailed Manufacturing Designs.
- Definition of the manufacturing strategy through distortion simulations and tolerance control during production activities;
- Preparation by supplier of the manufacturing drawings for Sector 5, requiring iterative work with F4E to implement important information about metrology and intermediate tolerances to be reached. A similar effort was devoted to preparing manufacturing procedures.
- Launch of the activities for the procurement of all main materials for the fabrication of the first three VV Sectors, 5, 4 and 3.

Technical Challenges

The main technical challenges encountered in the last quarter of 2014 and the actions undertaken to resolve them were as follows:

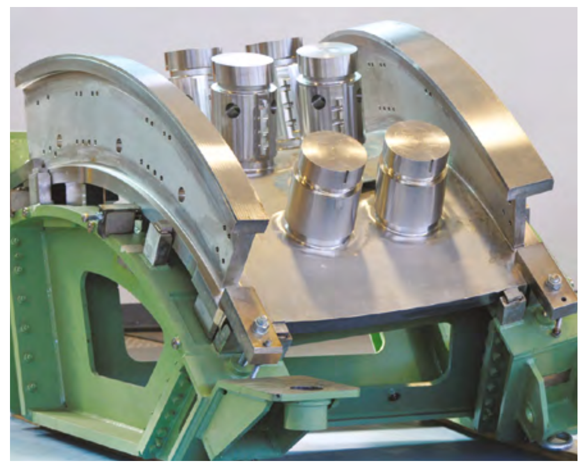
- During the fabrication of the mock-ups, issues were found leading to high distortions and insufficient quality of the root weld of the outer shell. Following a number of inspections performed on the mock-ups, AMW was asked to implement corrective actions.
- Qualification of material suppliers in general required an important effort as technical difficulties were met for the qualification of the stainless steel plate supplier, for forgings and filler material, especially with the inspection by ultrasounds. More in particular, the SS plates produced from the existing supplier showed several surface defects or cracks, generating the request for additional requalification tests by ITER IO/ANB and this slowing down the delivery of those plates to the manufacturing workshops.
- The fabrication of the jigs and frames that are needed to support the segment structures during sector production went slower than expected due to some delays in the design and issues related among others to weld quality. Several iterations to drive improvements were required.



PS2 under port mock up with IWS shielding blocks installed.

PS1 mock up under dimensional inspection.

VV Sector scaled mock up.



PS2 mock up in intermediate stage.

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 2014 are as follows:

- Signature of three contracts (OPE-443 lots 1, 2 and 3) for the manufacture of full-scale prototypes of the ITER Normal Heat Flux (NHF) First Wall (FW) panels;
- Procurement of CuCrZr alloy and 316L stainless steel plates for the performance of the above contracts on the manufacture of full-scale FW panel prototypes;
- Completion of the second blanket first wall qualification prototype manufactured in the frame of the contract OPE-284;
- Successful High Heat Flux (HHF) testing at Forchungszentrum Jülich, in the frame of the grant agreement GRT-154, of the first half of the blanket FW qualification semi-prototype manufactured in the frame of the contract OPE-284;
- Launch of a competitive dialogue (OMF-567) for the selection of additional potential suppliers for the procurement of the All-Tungsten Divertor Inner Vertical Target (IVT);
- Procurement of alternative Tungsten and CuCrZr alloy material (OPE-635) for the divertor IVT;
- Successful HHF testing at FE200 of Le Creusot of a second all-Tungsten qualification semi-prototype manufactured in the frame of the contract OPE-138 lot 1;
- Signature of the third framework contract (OMF-444 lot 2) for the manufacture of the divertor cassette bodies.

Progress Report on In-Vessel Components

During 2014, progress in the development of in-vessel components was achieved for the following systems: the blanket first wall, the divertor inner vertical target and the divertor cassette body.

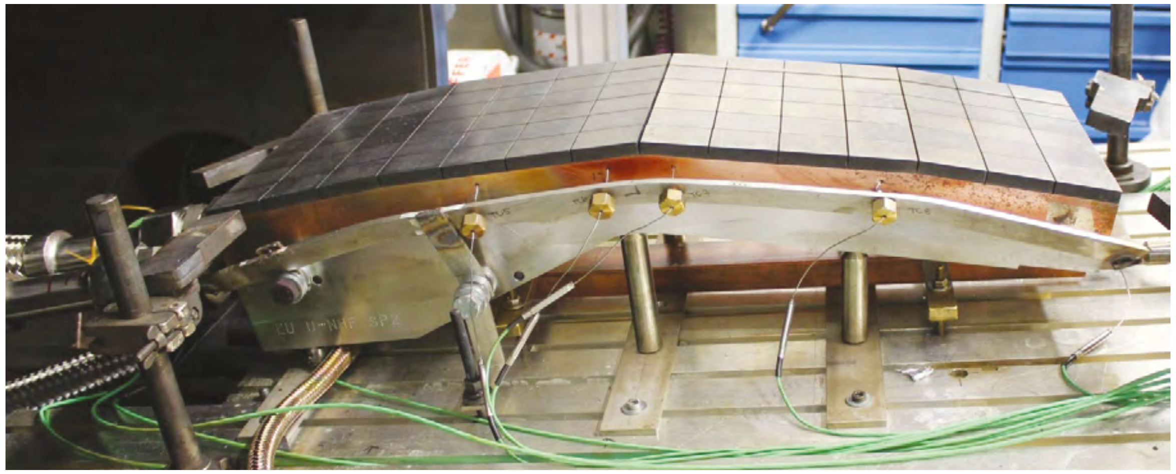
Progress Report on the Blanket Cooling Manifold

Procurement activities for the blanket cooling manifold are on stand-by, waiting for the completion of the design by the ITER IO. The Final Design Review is planned for December 2015.

Progress Report on the Blanket First Wall

Main achievements in the area of the Blanket first wall (FW):

- R&D in support of the FW procurement: additional activities on the development of the copper-chromium-zirconium (CuCrZr) alloy for the hot isostatic pressing manufacturing route (OPE-532 Lot 1 and Lot 2) of the FW panels aimed at identifying new material suppliers for the series production and at producing raw material for the full-scale prototype development and manufacturing. Continuation of activities on irradiation and post-irradiation thermal creep of 316L stainless steel/CuCrZr joints (GRT-291) and on irradiation and post-irradiation mechanical characterisation of the CuCrZr alloy (GRT-043).
- Normal Heat Flux (NHF) FW design and analysis to support the ITER IO performed in the frame of the Blanket Integrated Product Team (BIPT) Task Agreement as follows:
  - o Development by F4E of the detailed three-dimensional computer-aided-design (CAD) models and associated two-dimensional drawings of the ten main variants and 18 minor variants of the 215 FW panels in the F4E scope of supply for the ITER blanket. The main variants were finalised by December 2014 and all the minor variants will be finalised during the first quarter of 2015. The finalisation of the set of CAD models for main and minor variants represents the basis for the PA signature expected by July 2015;
  - o Design and analysis activities (OMF-457-01-01) of the following FW panels (main variants) to be procured later by F4E: FW11A, FW11B, FW13AD. Dedicated analysis performed for studying the effect of diagnostics integration in NHF FW panels (Finite Element Method simulation performed for FW6 in the scope of OMF-457-01-01).
- Closure of ITA C16TD148FE, aimed at the determination of non-destructive examination acceptance criteria for the manufacture of FW panels. Reports about High Heat Flux (HHF) testing of FW mock-ups with artificial defects have been completed, as well as ITA's overall final report. Conclusions were discussed with ITER IO during the closure meeting held in Cadarache in June 2014.
- The preliminary design for an Electron-Beam Test facility by CV Rez mainly devoted to the heat flux testing of FW panels during series production (OPE-319) has been completed. The detailed design is in progress.
- Concerning the ITER FW qualification programme to prepare for the procurement of the FW panels, the main developments have been:
  - o Signature and kick-off of three procurement contracts for the fabrication of NHF FW qualification full-scale prototypes (OPE-443 lots 1, 2 and 3 with Alcen/Atmostat, Areva and the consortium Iberdrola/AMEC/MIB respectively) with the aim to promote competition and mitigate technical and commercial risks for the future series production;
  - o Follow-up of the three procurement contracts for the fabrication of normal heat flux first wall mock-ups and qualification semi-prototypes (OPE-097-02, OPE-284 and OPE-394 with Alcen/Atmostat, Areva and the consortium Iberdrola/AMEC/MIB respectively). In particular, the manufacturing of a second semi-prototype by Areva (OPE-284) has been completed in November 2014;
  - o The first half of the first semi-prototype completed earlier under OPE-284 was HHF tested in the electron-beam test facility JUDITH2 at the Forschungszentrum Jülich in the frame of the grant agreement GRT-154. A further test campaign will be performed for the second half of the FW panel in the frame of the contract OPE-400;
  - o Other HHF tests activities, as specified in the grant agreement GRT-154 and the contracts OPE-400 and OPE-422, were performed on FW mock-ups to optimise material joining conditions and further enhance performance.

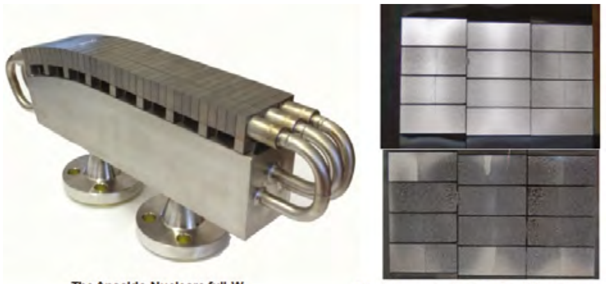


First Wall qualification semi-prototype manufactured by AREVA and tested at JUDITH-2

Progress Report on the Divertor Components

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

- Further to the decision from Plansee SE to withdraw from future procurement of the ITER divertor IVT and taking advantage of the on-going re-scheduling exercise of the ITER Project, a Call for expression of interest was launched to implement a competitive dialogue (OMF-567) for the selection of additional potential suppliers for the procurement of the IVT. Three meetings were held with the selected companies to discuss the terms and the scope of the framework contract, which has been split into two stages. The first stage concerns fabrication technology demonstration and validation on smaller scale components allowing successful candidates to participate to a re-opening of competition for stage two for a pre-qualification on full-scale components. A fourth meeting will be held early 2015 and the signature of up to three contracts is planned by mid-2015;
- To save time for the above procedure and mitigate technical risks by testing alternative Tungsten and CuCrZr alloy grades, F4E has procured Tungsten monoblocks and CuCrZr pipes from AT&M company (OPE-635);
- The on-going activities with Ansaldo Nucleare aiming at manufacturing full-size prototypes have continued (OPE-138 lot 1). The manufacturing of the tungsten monoblocks including W plate machining and pure copper casting has continued. The initial documentation has been released. Monoblock attachment load carrying capability has been assessed and fulfils the requirements. The welding qualification has started;
- The HHF thermal fatigue testing of mock-ups and prototypes for the qualification of all-tungsten monoblock components has continued at AREVA-Le Creusot (OPE-423). An important performance was achieved on a medium size mock-up manufactured by Ansaldo Nucleare: the mock-up withstood 5,000 cycles at 10 MW/m^2 plus 1000 cycles at 20 MW/m^2 exceeding therefore the ITER requirements. Then a subsequent critical heat flux test (CHF) on W monoblocks has shown values as high as 35 MW/m^2;
- The destructive examination (GRT-369) of all-W mock-ups HHF tested has continued at Forschungszentrum Jülich. The activity was focussed mainly on the study of the thermal fatigue performance of the CuCrZr tubes produced by Plansee and Elbrodur tubes used by Ansaldo Nucleare.



The Ansaldo Nucleare full W medium scale mock ups

W surface conditions after 300 (up) and 1000 (down) cycles at 20 MW/m2

Concerning the divertor cassette body, at the beginning of 2014 the three multiple framework contracts for the procurement of the divertor cassette bodies (OMF-444 lots 1, 2 and 3) were signed. The baseline of these contracts consists of the manufacture of one full-scale cassette body prototype and for the successful companies to participate to a re-opening of competition for the series production. During 2014 good progress was made by the three companies. The contracts' Quality Plans have been approved by F4E and ITER IO. The material purchasing orders have been issued. The initial documentation including drawings and preliminary welding data packages was delivered.

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 2014 are as follows:

- Signature of the DRHS procurement contract (OMF 340 lot 1) with Assystem UK 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;
- Execution of the dialogue and tendering phase for the NBRHS, and completion of most of the tender evaluation;
- Successful Conceptual Design Review for the IVVS, with a substantial contribution from F4E;
- Execution of the dialogue-tendering phase for the IVVS procurement (OMF 383) and invitation to tender to the pre-selected European industries;
- Start of the dialogue-tendering phase for the CPRHS procurement (OMF 577) with the pre-selected European industries;
- Signature of the procurement arrangement (PA) for the IVVS;
- Placement of Task Orders with the F4E RH engineering support contractor (OMF 272) in support of:
  - o Evaluation of tender for NBRHS;
  - o IVVS and CPRHS procurement and tendering (risk and cost analysis, business case analysis, respectively);
  - o Preliminary assessment of radiation hard digital cameras;
  - o CPRHS technical risk mitigation;
  - o Study of cables length issues, actuators failure modes and 3D stereo viewing performance.
- Signature of the license contract with the European Commission for the GENERIS robotics control software;
- Placement of task order with F4E CODAC engineering support contractor (OFC-361) for the preparation of a development plan for the GENROBOT equipment controller project.

Progress Report on Divertor Remote Handling

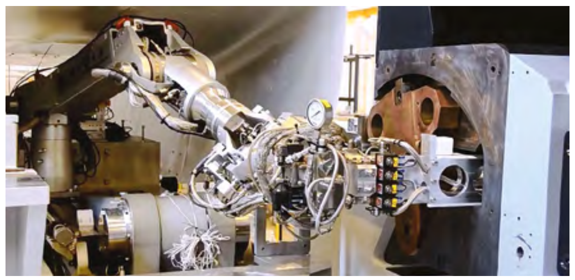
The tender evaluation for OMF 340 lot 1 led to the awarding of a contract to AUK as the first in the cascade (with Areva-Astrium and AMEC as the second and third respectively). Following the signature of the framework contract at the end of April 2014, the first task order (running until May 2015) has been launched in mid-July 2014 following an extensive preparation of the activities, and covers the the analysis of the system requirements, the assessment of the existing conceptual design and the drafting of an implementation plan for the whole procurement (with particular attention to the imminent preliminary design phase). The outcome of this task order will be utilised to define the next task orders starting with the preliminary design phase.

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 GRT-401 (that is going to finish during early 2015). In particular, in September 2014 a full remote sequence has been demonstrated where the so-called second cassette has been installed/removed into/from its in-vessel position by commanding and controlling the task from the remote control room. The figures below illustrate some of the operations, while video clips showing the handling sequence are available at the following links:

https://www.youtube.com/user/RovirFinland/
https://www.youtube.com/user/ihatut/

A similar operation is planned during early 2015 with the central cassette whose locking system has been designed by VTT in collaboration with ITER IO (which contracted them separately for this divertor-specific design activity) and involving also F4E for the grant-related implications.

Remote Handling operators in the control room commanding a robotic arm for the insertion of a compressing jack tool into the divertor cassette



The remotely commanded robotic arm inserting a hydraulic jack into a slot of the divertor cassette

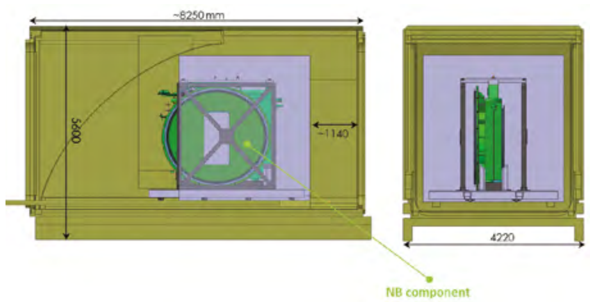
Progress on the Cask and Plug Remote Handling System (also known as the Transfer Cask System)

The main achievement for the CPRHS has been the launching of a new procurement procedure (OMF 577) after the original procedure (OMF 340 lot 2) expired after two years. The decision was taken not to renew the original procedure as it was considered more appropriate to probe the market again and find out a more up-to-date list of bidders with the aim to strengthen the field of competitors. In fact, after the re-launching of the Call for expression of interest in May 2014, and the pre-selection of the candidate European Industries, the dialogue-tendering phase was launched in December 2014 with three bidders. The next step will be the presentation of the business case to the bidders in January 2015 (which the tenderers will undertake to demonstrate their competence against a representative set of tasks related to the design and manufacture of this safety important system).

In parallel to initiating OMF 577 the preparation of the Procurement Arrangement has moved on, with the contribution by F4E to the drafting of the related documentation and with the execution of a task order (under OMF 272) to analyse the procurement costs and risks.

Furthermore, another task order has been launched in 2014 (still on going in 2015) in order to better address some specific technical issues that may affect the CPRHS procurement such as:

- The analysis of the system technical requirements;
- 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 (see figure below)
- a technical assessment of the seal design when two casks are docked together as is the case of two Blanket RH casks.



Concept of an extra-large cask for Neutral Beam components

Progress on the In-Vessel Viewing and Metrology System

The IVVS Conceptual Design Review (CDR) has been successfully held in May 2014 with a significant contribution from F4E RH team on the design of the system.

This has allowed F4E to start the preparation of the IVVS PA documentation in close liaison with ITER IO, and has led to the signature of the PA in December 2014. A Task Order (within OMF 272) has been executed in support of the procurement preparation related to the cost/risk analysis of the IVVS and to the assessment of the business case to be annexed to the procurement procedure (OMF 383).

In parallel, the procurement procedure has been launched in July 2014 with the invitation to the dialogue-tendering phase of four pre-selected bidders (two of which subsequently withdrew). The closure of the dialogue and the launch of the tender have been achieved in December (offers due in February 2015).

During 2014, furthermore, considering also the outcome of the CDR, it has been decided to prepare a new task order (within OMF 272) to perform further optical studies and analyse deeper some aspects of the design linked to the vacuum feed-through (activity due to start during early 2015).

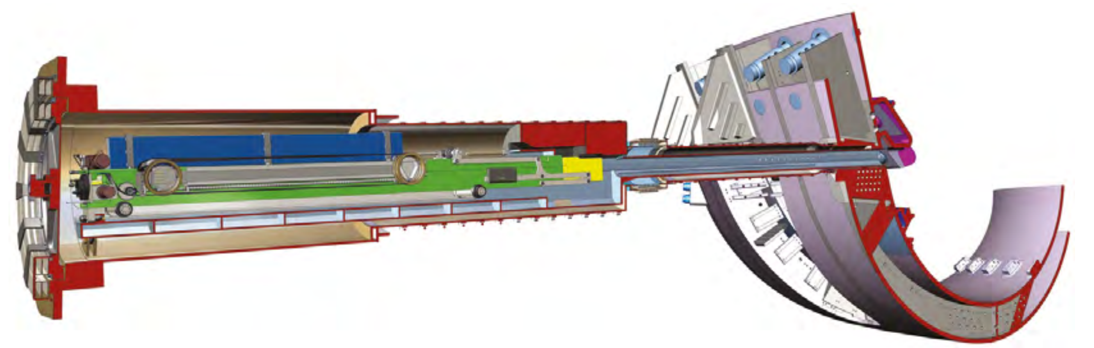
Progress on Neutral Beam Remote Handling

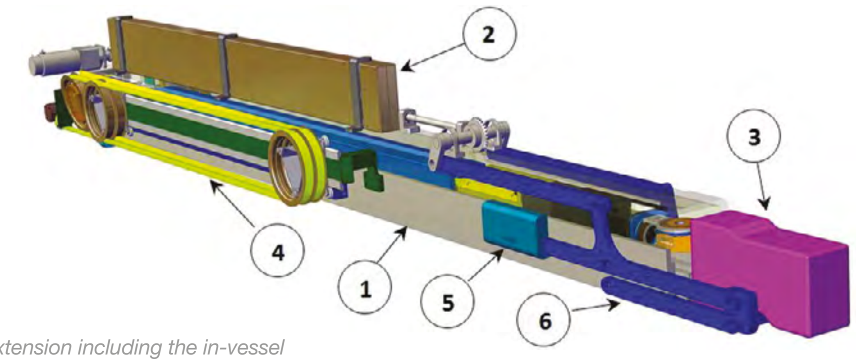
One major activity has been the completion of the dialogue with the pre-selected bidders for OMF 340 lot 3 (NBRHS procurement contract) and the launching of the related invitation to tender during the first half of 2014, followed by an intense tender evaluation that has taken the remaining part of the year, given the complexity of the bids that included the business case. This case is a comprehensive engineering study where the tenderers have the opportunity to demonstrate that they master all the necessary skills required for the execution of the framework contract.

Most of the tender evaluation has been completed in 2014 and the related award decision is going to be ready for approval in January 2015.

In parallel, Grant-0514 for "Remote pipe & lip seal maintenance R&D" has been started in February 2014 and during the year of reference, in particular the design of the prototype pipe tooling, with support by basic proof-of-principle tests, has been completed, as a prelude to the manufacturing of the real hardware.

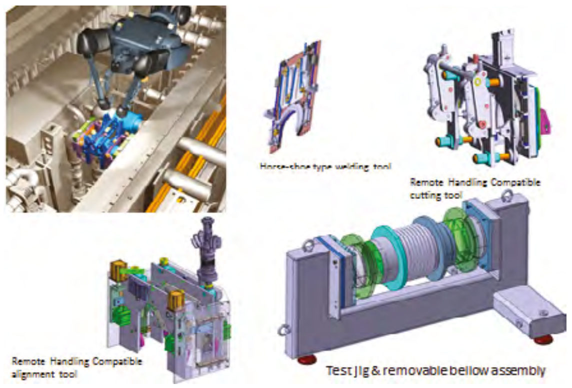
As an alternative solution for welded lip seals, the potential use of metallic seals for the main beam injector vessels was investigated, along with an impact study of a redesigned access door (OMF-272-01-14).





1: Cartridge frame
2: Push-chain magazine
3: B_4C movable block
4: Cable loom
5: Counterweights
6: Leverages

(Top) Section view of the port extension including the in-vessel viewing system plug
(Bottom) Details of the mobile assembly (the IVVS probe is behind the shield element 3)

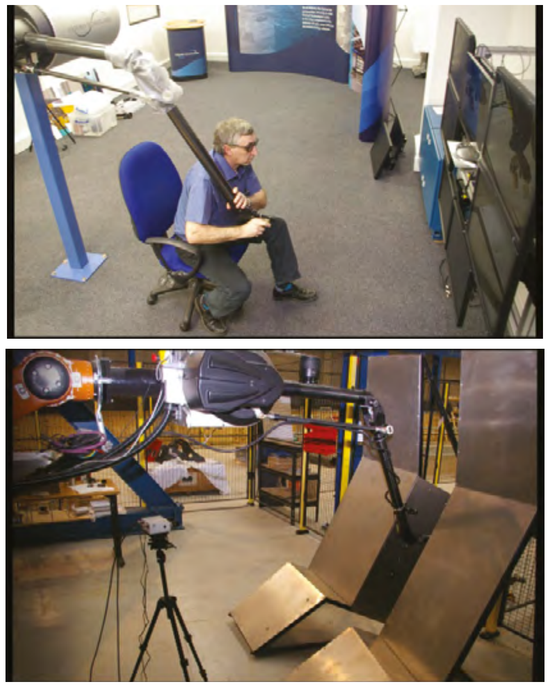


Snapshots illustrating the NBRHS pipe tooling design

Progress on 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 2014, significant progress was made by consolidating a cost-efficient development strategy, preparing development activities, investigating potential technical issues and assessing the suitability of advanced technologies. In particular, the following activities were undertaken:

- Establishment of a development plan for the control system of the DRHS focused on the realisation of generic functional modules suitable also for other remote handling packages;
- Preparation of a development plan for the so-called GENROBOT project, aiming at obtaining a generic robot controller for the various RH equipment, using the existing GENERIS software owned by the European Commission (developed at ISPRA JRC);
- Experimental study on technical issues caused by long cables length for actuators control, and possible solutions;
- Study on actuators failure modes to support actuators design, operators diagnostics and preventive maintenance;
- Experimental assessment of 3D stereo viewing for safe and efficient remote operations in the frame of a task order within OMF 272.



Master-slave tele-operation using a 3D stereo viewing system at OTL (OMF 272 contractor): the operator in the control room (left picture) is wearing 3-D glasses to watch the screen and control at distance the slave arm (right picture) located elsewhere (stereo-camera on the tripod)

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

Within the radiation hardness coordination 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 and in order to improve umbilical harness management and communication between remotely operated field equipment and the control room, a radiation tolerant front-end chip for read-out and multiplexing of embarked sensors of the DRHS was designed and is being assessed under radiation up to a cumulated dose of 1 MGy (F4E-OMF-272-01-10), with support from an external expert.

In parallel, following a study of the viewing needs and available solutions to support all remote handling operations (OMF-272-01-13), the design of a miniaturised radiation tolerant CMOS-based camera was prepared (OMF-272-01-18 to be launched in 2015).

Meanwhile, a collaboration agreement with CERN on radiation damage studies has been established.

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 2014 are the following:

Cryoplant

- The kick-off meeting of the contract OPE-376 for the procurement of the Liquid Nitrogen Plant and Auxiliary Systems took place in January 2014;
- The preliminary design was performed on schedule and was assessed by a preliminary design review held in F4E premises on 1-3 September 2014;
- The steering committee of the preliminary design review concluded that the proposed design was up to the requirements and sufficiently mature to authorise starting the next phase of the project;
- The purchase orders of the long lead items (compressors, heat exchangers, quench tanks, liquid helium tank, liquid nitrogen tank) were launched in November and December 2014.

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

- The contract for the procurement of the warm regeneration lines was awarded in July 2014;
- The manufacture of the pre-production cryopump continued. Significant effort was spent in addressing some non-conformities and in the management of the numerous subcontractors to safeguard the quality standards required for this pump which has the highest safety and quality classifications;
- The design for the cold valve boxes and the warm regeneration box has been completed and formed the basis for the related preliminary design review performed by ITER IO.

Tritium Plant

- The final design and procurement of WDS (Water Detritiation System) large tanks (volume ≥ 20 m^3) was carried out by ENSA in the frame of the contract F4E-OPE-500. After a successful final design review and manufacturing readiness review, manufacturing was started. Tank deliveries to ITER IO are scheduled in the first half of 2015 for installation in the Tokamak building in mid-2015;
- The preliminary design for the WDS (excluding tanks) proceeded in 2014 through contract F4E-OPE-421 placed with Kraftanlagen. Process, piping and instrumentation diagrams together with the system functional analysis were produced for submission to ITER IO HAZOP early 2015.
- Grant agreement for R&D in support of the Isotope Separation System (ISS) conceptual design (F4E-GRT-440) was completed at the Karlsruhe Institute for Technology and the linked ITA (TA-FCIPT-10-03-11-103-EU4) closed.

Waste Management System (WMS)

- The negotiation of the Type-A Radwaste Procurement Arrangement was started. The first two draft versions of the technical requirements were reviewed by F4E and discussed with ITER IO;
- A task order for the cost assessment at completion of the Type-A Radwaste package was executed in 2014. This cost assessment reflects the changes introduced by the Hot-Cell Complex Task Force. The cost at completion figure will be used in order to ensure coherence between scope and credits.

Radiological and Environmental Monitoring Systems (REMS)

- The task order F4E-OMF-298-02-01-01, partially implementing the REMS Design procurement arrangement was signed and a kick-off meeting was held at the beginning of 2014. REMS architecture was established together with instrumentation and control list of data, variables and signals. Design reports reflecting such architecture were produced by AMEC.

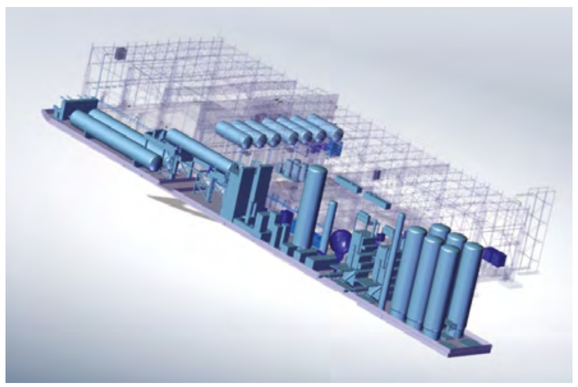
- The preliminary list of REMS Defined Requirements was agreed with ITER IO and provided to AMEC for implementation in the REMS design.

Progress Report on the Cryoplant

After signature of the contract for the Liquid Nitrogen Plant and Auxiliary Systems procurement with Air Liquide in December 2013, the kick-off meeting took place on 21 and 22 January 2014. The contract execution was launched at full-speed in order to meet the challenging schedule and make sure that the data required for the design of interfacing systems such as the building and the other equipment of the cryoplant could be provided according to the ITER integrated schedule.

A task order was also awarded to GTD Sistemas for integration of the Liquid Nitrogen Plant and Auxiliary Systems process control within the ITER machine overall control system.

The preliminary design studies allowed F4E to define the layout and space allocations (see figure below), process flow diagrams and process data, piping and instrumentation diagrams, main specifications of the equipment, process control description, electrical diagrams, etc.



Layout of the various components of the Liquid Nitrogen Plant and Auxiliary Systems

Innovative design choices were made: centrifugal compressors for the 80K loop compressor stations, brazed aluminum heat exchangers and a stainless steel printed circuit heat exchanger for the 80K loop cold boxes, large-sized single liquid helium tank with attached valve box, two vacuum insulated quench tanks with external circulators.

A major milestone was achieved with the preliminary design review of the Liquid Nitrogen Plant and Auxiliary Systems on 1-3 September 2014 which took place at F4E. The design review panel included international experts in cryogenics and delivered an independent assessment of the preliminary design. 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 final design of the Liquid Nitrogen Plant and Auxiliary Systems.

The purchase orders of the long lead items, i.e. the components which are on the critical path regarding the delivery schedule, were launched in November and December 2014. The main items included compressors, heat exchangers, quench tanks, a liquid helium tank and a liquid nitrogen tank.

The long-term schedule was updated with a special emphasis on the delivery dates of the components and the on-site installation activities.

Progress Report on the Cryopumps and Cryodistribution Lines

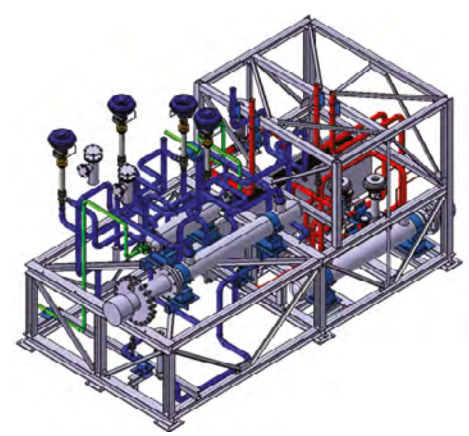
The contract for the procurement of the warm regeneration lines was awarded to Criotec in July 2014 and the kick-off meeting took place on 1 October 2014.

The pre-production cryopump manufacture, under task agreement C32TD31FE, is a major pre-procurement arrangement activity for the built-to-print definition of the torus and cryostat cryopumps. It is also intended as a spare cryopump. Significant effort was spent to address some non-conformities that were identified, especially in some manual welds, and in the management of the numerous subcontractors to safeguard the quality standards required for this pump which has the highest safety and quality classifications.

A cryopump thermal shield undergoing cold shock tests (courtesy of RI/SDMS)

A cryopump thermal shield undergoing cold shock tests (courtesy of RI/SDMS)

The design for the cold valve boxes and the warm regeneration box was completed and formed the basis for the related preliminary design review performed by ITER IO in December 2014. These components play a key role in the safe and timely operation as well the as regeneration of the ITER Torus and cryostat cryopumps.



View of the pipe arrangement in the warm regeneration box (courtesy of IDOM)

F4E contributed to the conceptual design review of the primary leak detection performed by ITER IO in December 2014.

A complete review of the schedule of all activities was done to fully reflect current progress and risk. All components remain well outside the critical path for ITER construction, apart from the Neutral Beam cold valve boxes due to interfaces with the buildings.

Progress on the Tritium Plant

Water Detritiation System (WDS)

In the frame of the contract F4E-OPE-500, Equipos Nucleares S.A. prepared a design for the WDS large tanks, two 100 m^3 tanks and four 20 m^3 tanks, which passed successfully the final design review in February 2014 and the manufacturing readiness review in June 2014. Manufacturing activities started with procurement of the stainless steel plates, and continued with forming and welding operations of the various parts.

The tanks are scheduled to be completed early 2015 and, after the factory acceptance tests such as hydraulic test pressure and vacuum helium leak test, they will be shipped to ITER IO using DAHER logistics services.

In the frame of a contract (F4E-OPE-421) placed with Kraftanlagen Heidelberg GmbH, the WDS preliminary design was developed up to the preparation of the design package to be submitted to the ITER IO HAZOP assessment. The package contains process, piping and instrumentation diagrams together with the system functional analysis and a preliminary layout in the building. HAZOP is scheduled in early 2015.

Isotope Separation System (ISS)

In the frame of F4E-GRT-440, two packing types for the ISS cryo-distillation columns were characterised with reference to hydrogen separation and inventory performance carried out following procedures agreed with ITER IO. The data recorded during these experimental campaigns is fundamental for designing the ITER ISS.

The same contract also covered a worldwide review of software for ISS design. A matrix questioner was agreed with ITER IO and sent to the owners of potentially suitable design software. The replies from various companies were evaluated against criteria agreed with ITER IO and three codes were identified as suitable for the ISS design.

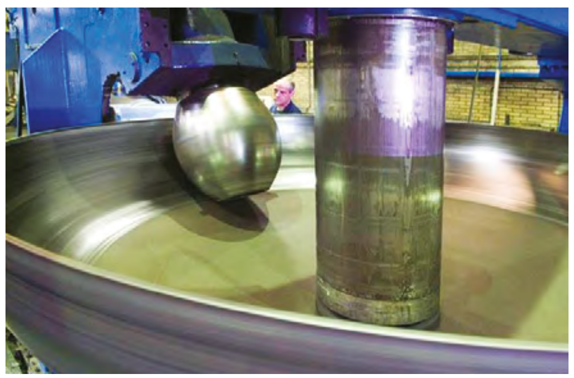
Progress Report on the Waste Management System

As for the Waste Management System, the activities in 2014 were devoted to starting preliminary negotiations with ITER IO on the procurement management technical requirements, based upon the new design provided by the Hot-Cell Complex-Task Force.

Two versions of the technical specifications were proposed by ITER IO and reviewed by F4E. A preliminary agreement was reached on the definition of the procurement arrangement scope, based on the current baseline.

At the same time, in the frame of the establishment of the F4E cost baseline, a task order for the cost assessment at completion of the Type-A radwaste package was placed. The cost assessment report is detailing the cost breakdown structure of the package, divided in the different phases of the system life-cycle: design, procurement and manufacturing, packaging and shipping, installation and commissioning.

Cold forming of 100 m³ tank shell sector.

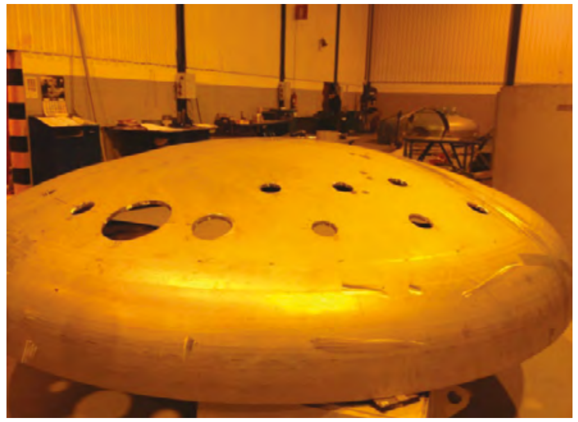


20 m³ tank head cold forming.

Welding of shells of 20 m³ tank.

Support legs.

Shells of 100 m³ tank with holes for nozzles.



Head for 20 m³ tank with holes for nozzles.

Progress Report on Radiological and Environmental Monitoring Systems

As for the Radiological and Environmental Monitoring Systems (REMS), at the beginning of 2014, a contract with AMEC for the development of the preliminary design of the system for the tokamak complex was signed and the kick-off meeting held.

During the same period, a series of meetings between ITER IO and F4E were organized in order to discuss and agree the initial list of REMS defined requirements for all activities performing protection important functions. The requirements list was then populated with verification activities, to be executed during the system life cycle, and sent to AMEC for review and implementation of the design.

The following reports were delivered and discussed with ITER IO: functional analysis, load specifications, detailed performance definition, process flow diagrams, architecture, control and instrumentation, operation plan, maintenance plan, design review recommendations, FMECA, RAMI, HAZOP, qualification report for PIC components.

Similarly to the other packages, much effort was dedicated to planning and scheduling.

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), 32% of the gyrotron sources and 67% of the power supplies (8.010kIUA and 11.628 kIUA respectively).

Executive Summary

In the area of the radio and microwave heating systems, the main highlights during 2014 are as follows:

- The fabrication of the short pulse 1 MW gyrotron has been completed and the experimental campaign started. The first results (>1 MW of very good quality output Radio Frequency (RF) power) are showing that the EU gyrotron design is compliant with the ITER specifications. In parallel the manufacturing design of the 1 MW Continuous Wave (CW) gyrotron prototype was finalised and the procurement and manufacturing activities started;
- The design of the European power supplies for the ITER electron cyclotron system has been realised and the final design review performed and approved.
- The framework contract for the final design of the Ion Cyclotron antenna Heating (ICH) antenna is signed and the first task order is on-going;
- The testing of the Faraday Screen mock-ups for the ICH has been completed successfully;
- For the Electron Cyclotron Upper Launcher, the qualification of components with nuclear safety/protection functions (PIC) has started.

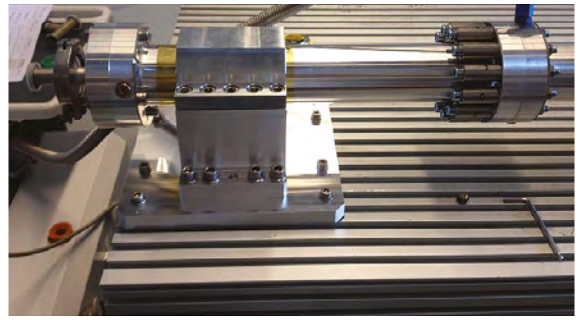
Progress on the Electron Cyclotron Upper Launcher

Work towards the final design of the electron Cyclotron Launchers has continued in 2014.

The progress of the design and analysis work has been much slower than planned due to a number of significant changes in critical interfaces (physical and functional) of the launchers, already started in 2013. The situation of flux in the interfaces has not stabilised rapidly, especially the uncertainties related to the vacuum vessel port extension and the environment dose rates. These changes have forced a temporary halt to the final design activities to evaluate the impact of those changes on essential design parameters, including maintenance schemes, of both in-vessel and ex-vessel components of the launcher.

Design decisions have been reached and a new plan for the final design implemented with the ECHUL-CA consortium. The new design concepts are still subject to full confirmation by analysis and test, with the most important being a reduction of the waveguide diameters and changes in related optical components, port plug structure thickness and back-plate layout. Other changes are still under study, including modification of the port plug blanket.

Test rig to characterise the mechanical behaviour of the double helicoflex seals and measure the leak tightness under axial loading and temperature variations



Test rig to measure the leak tightness performance of the waveguide coupling assembly under bending and torsional loads.

Although a large fraction of the available resources has been used for reacting to changes "external" to the launcher, progress has been made on some aspect of the design, notably on the window design a prototyping. The procurement of prototype disks has started in 2014 (OPE 561), manufacturing optimisation of the window structure has also progressed (OPE 467).

The work on the new waveguide couplings has been completed (OPE 528). Pre-qualification tests have been performed to support the design development of the waveguide couplings for the launcher. The new integrated coupling design is more compact than the previous solution and is now capable of sustaining the mechanical loads imposed by the displacement of the vacuum vessel interface during normal operations, baking and plasma disruption events. The new design complies with stringent requirements for component alignment imposed by the transmission of the high power mm-wave beam. The vacuum and confinement performance meet the ITER requirements and the couplings design is now mature for the formal qualification phase.

Activities in the area of requirement identification, management and design verification have continued, as well as those on nuclear safety analysis (OFM 298, in collaboration with F4E safety).

Progress on the Ion Cyclotron Heating

The framework contract for the final design of the ITER ICH antenna was signed in January 2014 with the CYCLE consortium (CYCLE consortium: CCFE, CEA, ERM, IPP and Politecnico di Torino). The framework contract will cover the completion of the design, the preparation of the built to print drawings and of the technical specifications for procurement and general support to procurement preparation. The design work is carried under an ITA. Three task orders were prepared in 2014 in collaboration with ITER IO. The first task order is aimed at building a requirement database and at providing general engineering support activities. The work started October 2014. Two further task orders were planned and prepared in 2014. One was aimed at the completion of the mechanical analysis of the antenna, to guide the second phase of the design. ITER IO management decision prevented the work to be launched, given the changing interfaces in the port plug environment. Another task order, aimed at finalising the design of the Faraday screen and producing the design of its prototype, has been waiting input on the finalisation in ITER IO of the plasma loads on the Faraday Screen. Both are now planned for 2015.

January 2014 saw also the completion of the neutronic analysis of the antenna (under F4E analysis framework contract). The analysis included the determination of the shutdown dose rate (SDR) in the port interspace and of the relative contribution to the SDR of the ICRH port and the neighbouring ports.

High heat flux testing of the Faraday Screen mock-ups has been successfully carried out in 2014. Both mock-ups have survived 15,000 cycles at 3.5 MW/m^2 (as required by the ITER specifications) with no modification of their thermal behaviour. Both mock-ups showed thermal defects after ~500 cycles at 5 MW/m^2 and failed after 16 cycles at 6 MW/m^2. Post mortem tests of the mock-ups are planned for 2015 and the contract for the manufacturing of the prototypes is now planned for 2016.

The contract for pre- and post-irradiation material property measurements, aimed at choosing one alumina grade for the window manufacturing and qualifications, out of six possible grades, has been under negotiation in the second half of 2014. A new offer is expected in 2015. To support this choice, a second activity for the study of the brazing of the Alumina grades and titanium has started and progressed in 2014 under an F4E technical support services framework contract.

Finally, F4E has continued to provide support to ITER IO for design reviews, project and technical meetings related to the ICH antenna and to the ICH system in ITER.

Progress on the Electron Cyclotron Radio Frequency Sources and Power Supplies

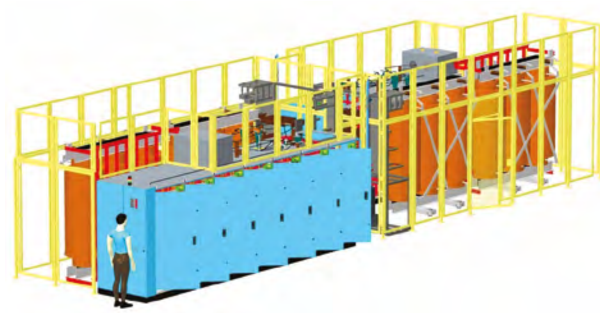
The programme for the development of the 170 GHz, 1 MW, Continuous-Wave (CW) TE32,9 mode gyrotron for ITER has entered the fabrication phase. The manufacturing of a 1 MW short-pulse (pulses in the millisecond range) modular gyrotron has been finalised by Karlsruhe Institute of Technology (F4E-OPE-458) in collaboration with Thales Electron Devices (TED), and the RF tests started by EGYC (F4E-GRT-553) after the successful completion of the site acceptance tests in Karlsruhe (Germany). In particular:

- The short-pulse gyrotron features the same design of the RF and electronic components than the industrial CW prototype, which is under fabrication by TED while its technical design is simplified as most of the subassemblies are not actively cooled. The modularity of the short-pulse gyrotron allows for fast replacement and validation of subassemblies. The first tests, performed during 2014, on the short-pulse 1 MW gyrotron were fully successful: the gyrotron oscillates at the right mode and frequency and produces the expected RF power (>1 MW) with an excellent quality of the output beam and without any parasitic oscillations degrading its performance. The experiments will continue in 2015 to further explore the operational domain, determine the sensitivity to misalignments, and extend the pulse length up to ~10 mins.
- The manufacturing design of the 1 MW CW prototype (OPE-447) prototype was completed. Its delivery and start of the long pulse RF tests is planned by the end of 2015. The design of the EU gyrotron for ITER is defined as close as possible to that of the 140 GHz, 1 MW, 1800 s gyrotron for the W7-X Stellarator at IPP Greifswald, which is presently in the final phase of series production (6 gyrotrons have been delivery and accepted), and therefore, provides an excellent basis for the industrialisation of the EU gyrotrons for ITER;

- The gyrotron development strongly benefits from the modelling, design and testing capabilities of the EGYC consortium (KIT, CRPP, HELLAS, CNR, and USTUTT and ISSP as third parties). Under the F4E-GRT-432 and F4E-GRT-553, EGYC's effort focussed on i) the modelling of the gyrotron peculiar internal phenomena through the development and benchmarking of wave-beam codes, ii) the prediction and preparation of experiments and optimisation of the subassembly designs (e.g. sintered launchers, beam tunnels), iii) the characterisation of ceramic materials, iv) the development of a test bed for QA control of electron guns, and v) the preliminary design of the gyrotron auxiliaries for ITER. To mitigate the technical risk due to high peak of ohmic losses to be evacuated from the cavity inner walls (the ~ 22 MW/m^2 in nominal conditions could approach the technological limits), a dedicated mock-up has been designed, and is been fabricated for testing in the first half of 2015. Detailed computational fluid dynamic (CFD) analyses have been performed by POLITO (Politecnico di Torino) in the frame of F4E-OPE-031 for assessing the thermal hydraulic behaviour of the reference design for the dissipation of the gyrotron cavity loads Additionally, an alternative design solution for the cavity cooling has been identified and optimised and will be tested on a second mock-up by the end of 2015. Similarly, to optimise the gyrotron design for handling higher powers, CFD modelling efforts have focused on the possible optimisation of the collector design.

- The design of the power supplies for the EC Power Supply System (PS) was performed and the final design review successfully completed and approved, thus allowing the start of the manufacturing of the eight sets of PS which are under F4E's responsibility, by Ampegon, the supplier of contract F4E-OPE-454. Each PS set is composed of 1 Main (rated at 55kV/100A), and two Body HV PS (rated at 35kV/100mA) feeding the cathode and body of two gyrotrons each. The design documentation was subjected to a comprehensive review by the panel and F4E, ITER IO, ITER gyrotron suppliers and other experts. All participants acknowledged the high level of maturity of the design meeting all the design, functional and interface requirements. The functional performance of the EC power supply system is expected to be better than the specifications in terms of output voltage stability and dynamics behaviour, which favours the regulation and protection capabilities of the gyrotrons. The manufacturing of the first of the eight sets of the EC PS systems is planned to start in 2015. The delivery and installation of the first set, depending on the buildings availability, is planned in 2018.

The 1 MW short pulse gyrotron assembled (F4E-OPE-458)



A schematic view of one main HV power supply for the Electron Cyclotron System for ITER

Subassemblies of the 1 MW CW Gyrotron Prototype (F4E-OPE-447)

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 six NB procurement packages, which include beam sources, beam line components, confinement and shielding, coils, power supplies and assembly. A seventh major procurement arrangement covers the European procurements for the establishment of the Neutral Beam Test Facility (NBTF) in Padua, Italy.

Executive Summary

In the area of the Neutral Beam heating systems, the main highlights during 2014 are as follows:

- Major procurement contracts for the NBTF were signed in 2014 and the tendering procedures for many others were launched and progressed;
- The final design review was carried out for the core NBTF Components;
- Procurement activities for all the SPIDER test bed contracts progressed during 2014;
- The construction of the NBTF buildings at the Consorzio-RFX site in Padua has progressed well and the first areas have been handed over to F4E contractors for their on-site activities;
- Design work on towards the build-to-print specifications of the Heating Neutral Beam (HNB) components progressed and the design were submitted to the different reviews stages;
- The ELISE test facility in IPP has performed experiments obtaining very good results. The associated service contract was completed.

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 progressed well in 2014 in order to be ready for equipment installation at the end of 2014. The buildings, managed by Consorzio RFX are part of the Italian contribution to the establishment of the NBTF.

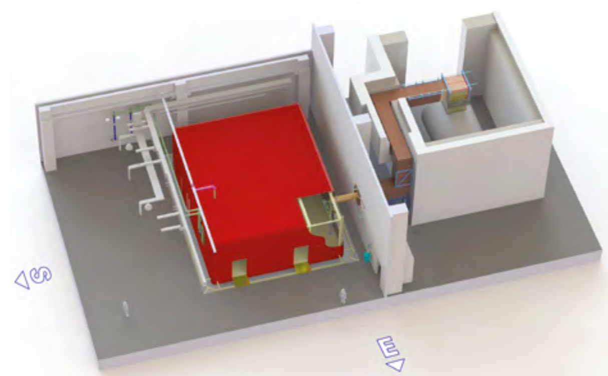
In 2014 the organisation of the construction site has been finalised, to allow the concurrent execution of works by RFX, F4E and other DAs. This has allowed the F4E contractors to start the on-site installation activities during the year.

Moreover F4E continued to provide support to the ITER IO to prepare the NB 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:

- After the preliminary design review was successfully completed in 2013, an amendment of the existing ITA/Grant has been signed in December 2013 to bring the design of the VVPSS box and Exit Scraper up to the final design review (passed in July 2014) and to finalise, at the required level of detail for PA signature, 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 preliminary design review for the Duct Liner, which will be procured by the Korean Domestic Agency, has been successfully held in September 2014;
- R&D activities were performed to verify the manufacturing procedures of special parts to be used in order to fulfil the stringent requirements of the high heat flux components;
- In the framework of the NBTF activities, the test facility for ultra-high voltage tests for vacuum insulation was fully commissioned and several experimental campaigns have been performed to verify electrostatic configuration of the beam source accelerator also in the presence of transversal magnetic field;

NBTF building under construction at the Padua site (Consorzio RFX premises)

- The overall factory acceptance testing of the Ion Source and Extraction Power Supplies (ISEPS, F4E-2009-OPE-046, OCEM ET SpA) for SPIDER took place in May 2014 at OCEM's premises near Bologna, Italy. Type and routine testing performed according to IEC standards at component level were supplemented with specific DC insulation tests on insulating equipment and customised power tests at system level ensuring compliance of the supply with the stringent requirements of the specifications. Very satisfactory test results were obtained, in full compliance with the test requirements. As part of the system tests, the full ISEPS system feeding one of the four RF generators equipped with a 50 Ohm dummy load was tested up to full RF power (200 kW) for up to 15 minutes. Following the completion of the tests, the equipment was put into storage, until delivery to the NBTF Site when ISEPS installation will start after the erection of the High Voltage Deck is completed, in 2015;
- Following completion of design activities for the HV Deck and Transmission Line for SPIDER (F4E-OPE-396, COELME SpA), manufacturing progressed through the year. Manufacturing and factory testing of the HV Deck was completed in 2014 and installation will start early 2015. Manufacturing and factory testing of the Transmission Line is scheduled for completion mid-2015;



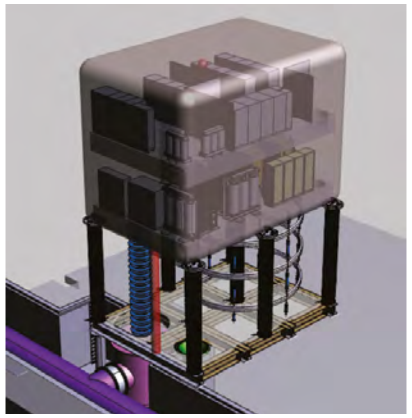
Overall layout system, across Building 6 (left) and Building 1 (right) of the NBTF – South East view

- The manufacturing of the vacuum vessel of SPIDER was completed in the second half of 2014 and the factory acceptance tests were passed;
- The MITICA Vessel contract was signed in December 2014;

Layout configuration for the full Factory Acceptance Testing of ISEPS of SPIDER at OCEM Energy Technology premisesPadova site (Consorzio RFX premises)

SPIDER vacuum vessel installation at NBTF

- The negotiations for the procurement of the 1 MV High Voltage Deck (HVD1) and HV bushing of MITICA and ITER injectors (OPE-083, Competitive Dialog) came to a successful conclusion in late spring 2014. Following the final Call for Tender and evaluation phase, the procurement contract was signed in December with SIEMENS AG. Design activities will start after the kick off meeting scheduled at the end January 2015, with the objective to complete the detailed design phase in October of the same year;



Reference design for the High Voltage Deck 1 (HVD1) and HVD1 Bushing of MITICA

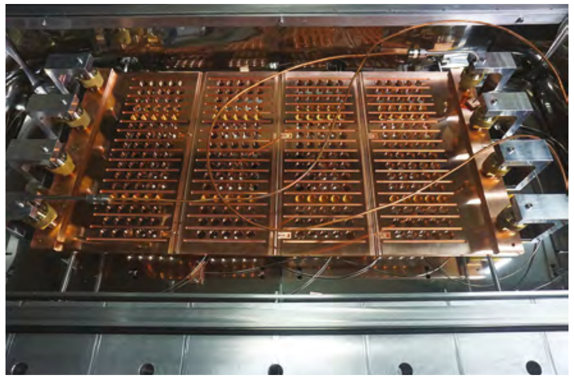
- The Call for tender for the procurement of the Acceleration Grid Power Supplies conversion system and Ground Related Power Supplies (AGPS-CS and GRPS, OPE-278, Open Call) was launched in November 2014. The contract is expected to be signed in the late summer 2015. This is the last main contract of PA (5.3.P6.EU.01) covering the European contribution to the NB Power Supplies for ITER and the NBTF in Padua, Italy;

- A Health and Safety organisation was put in place for the NBTF on-site activities fulfilling on one side the legal and regulatory local requirements and, on the other side, adapted to the unique and complex framework of cooperation between ITER IO, F4E, the NBTF Host (Consorzio-RFX) and the other participating DAs;

- The manufacturing activities for the NBTF Cooling Plant (F4E-OPE-351) supplied by Delta-Ti Impianti S.p.A. progressed well throughout the year with the F4E Electrical and Control & Command Detailed Design review successfully held in January 2014. The Cooling plant on-site installation started at the end of October 2014;

NBTF cooling plant on-site installation

- The SPIDER beam source fabrication progressed fairly well in 2014 and most of the first pieces of the most complex components were manufactured;



NBTF Cooling Plant on-site installation

- The manufacturing and factory test for the components for the gas storage and distribution, vacuum and gas injection systems for the Neutral Beam Test Facility were completed.

- The procurement of the SPIDER control and interlock system have been started.

- The MITICA beam source and beam line components final design review was held by ITER IO in January 2014 and closed in the second half of the year (with some points to be clarified in 2015). The design was accepted by the ITER IO and the finalisation of the technical specification for procurement started.

Diagnostics

F4E is responsible for the in-kind contribution of 13 distinct diagnostic systems, which comprise about one quarter of all ITER diagnostics. Additionally, F4E's diagnostics-related contributions include Tokamak Services (cable looms, connectors and feed-throughs) and integration design of diagnostics into seven ports housing 22 diagnostics systems from F4E, ITER IO and five other DAs.

During 2014, the F4E completed the signature of Framework Partnership Agreements (FPAs) to finalise the design of all the major diagnostic systems for which European Fusion Labs (EFLs) have the necessary capacity. An FPA establishes a long-term collaboration (for up to four years) with a beneficiary (which is often a consortium of EFLs), with the work itself performed under separate specific grant agreements so that the technical specifications of the design activity can be defined progressively, taking account of results of previous activities.

Similarly, a Framework Contract (FWC) was signed for the integration design of port-based diagnostic systems into ITER ports and the build-to-print designs of the housing and shielding structures hosting diagnostic components.

Significant progress was also made during 2014 for the Magnetics Diagnostic, including the signature of a contract for the series production of Continuous External Rogowski sensors, which constitutes the first contract for the manufacturing of diagnostic components for ITER.

Executive Summary

In the area of diagnostics, the main highlights during 2014 are as follows:

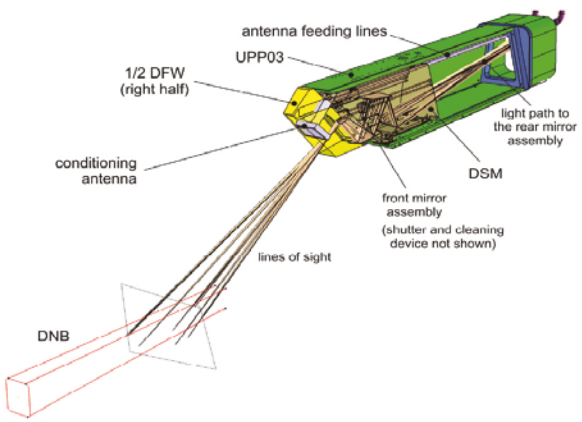
- FPA signed for Charge Exchange Recombination Spectrometry;
- FWC signed for Port Plug design, testing and diagnostic integration design;
- FPA signed for Low Field Side Collective Thomson Scattering;
- Contract signed for the Series manufacturing of the Continuous External Rogowski sensors.

Progress Report

Charge Exchange Recombination Spectrometry (CXRS)

The CXRS diagnostic views a region of the ITER plasma illuminated by a high-energy beam of neutral hydrogen particles injected into the plasma by a companion device being constructed by the Indian Domestic Agency. Collisions with particles in the fusion plasma produce visible light. Its wavelength and spatial distribution allow conclusions to be drawn on various properties of the plasma. The measurements provide information that is crucial for sustaining the fusion reaction. The density of helium, in particular, is recorded. Helium is formed during the fusion reaction and must be removed from the combustion chamber if the fusion fire is to be kept alight. Other important parameters such as the concentration, temperature and velocity of different plasma species can be determined using the diagnostic.

The FPA for the design of the CXRS diagnostic was signed in January 2014 with the IC3 consortium composed of six members and coordinated by Forschungszentrum Jülich (FZJ)



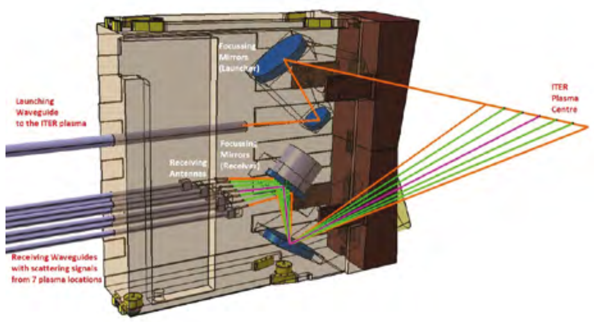
Schematic view of the Charge Exchange Recombination Spectrometry

Port Plug design, testing and diagnostic integration

In February 2014 the Framework contract for the Port Plug design, testing and diagnostic integration design was signed with the Spanish company IDOM Ingeniería y Consultoría SA.

The port integration consists of the integration design of port-based diagnostic systems into ITER ports and, second, production of build-to-print designs of the housing and shielding structures hosting diagnostic components. The integration design will consist of bringing together, via design optimisation and iterations, 20 diagnostic systems into five ITER ports, to share available space consistently.

The housing structures to be designed will host diagnostic components in the in-vessel part of the machine. nine different, complex, actively cooled, stainless steel housings are foreseen, weighing between 5 tons and 20 tons each, to meet diagnostics requirements while coping with the ITER environment (e.g. nuclear installation, safety, vacuum, plasma disruptions, plasma radiations, remote handling).



Schematic view of the Low Field Side Collective Thomson Scattering

Low Field Side Collective Thomson Scattering

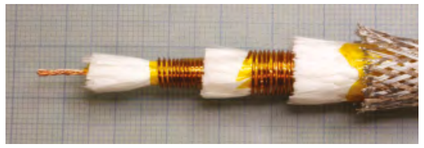
The Low Field Side Collective Thomson Scattering (LFS CTS) diagnostics system aims to characterise the velocity distribution function of fast ions, in particular the magnetically confined fusion alphas, in the ITER plasma. The CTS system measures the spectral power density of the scattered radiation from which the fast ion velocity distribution is inferred. The ITER baseline covers only the front-end of the LFS CTS which will be integrated in the equatorial port plug 12. The remainder of the LFS CTS system may be implemented later, during the operational phase of ITER.

The FPA for the design of the LFS CTS was signed in February 2014 with a consortium formed by the Technical University of Denmark (DTU) and the Instituto Superior Técnico (IST).

Continuous External Rogowski

In December 2014, the contract for the manufacture of the Continuous External Rogowski (CER) was signed with Axon' Cable SAS of France and Sgenia Soluciones SL of Spain.

The CER coils measure the total toroidal current flowing within the contour of the TF coils. This approximates to the plasma current under steady conditions, which is an important parameter with relevance for safety and machine protection. The CER is based on Ampere's law, which states that the contour integral of the magnetic field along any closed path is proportional to the current flowing through that path. The CER is arranged in a closed poloidal loop within the TF coil case, which encloses the plasma current as well as any toroidal currents in the vacuum vessel, and thus delivers a measurement of these currents.



Internal structure of the Continuous External Rogowski coils (prototype)

Significant additional progress was made in the area of Magnetics Diagnostics. Preliminary design reviews were successfully held for in-vessel discrete sensors and outer-vessel coils and a final design review was successfully held for the fibre optic current sensors. All the designs for these reviews were developed under F4E grants. Extensive testing of a long-pulse integrator for ITER magnetics, under an F4E contract, also yielded promising results, providing a favourable starting point for future design of this item.

Test Blanket Modules and Materials Development

ITER will play an essential role in the European Fusion Roadmap by providing a demonstration of the feasibility and performance of tritium breeding blankets of future fusion reactors. For this purpose, operation of Test Blanket Module (TBM) systems installed in ITER will provide a technological return on experience with essential information on the tritium breeding and extraction capabilities as well as the performance of an integrated system consisting of a breeding blanket mock-up (TBM) and its auxiliaries (cooling system, tritium extraction system). This information is needed before a DEMO reactor can be designed, constructed and operated with confidence.

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, being developed keeping in mind relevancy with a future DEMO, 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 eutectic. Consequently, the set of ancillary systems deployed to extract and recover the tritium out of each TBM is specific for each concept. Each TBM system is operated independently.

Executive Summary

In 2014 the main achievements in the area of the TBM systems are as follows:

- Two Arrangements between F4E and the ITER IO (TBM-Arrangements) have been signed for the delivery of TBM Systems and associated equipment/tools to the ITER site;
- The documentation for the Conceptual Design Review of the HCLL and HCPB TBM Systems has been finalised; including functional analyses, systems design description, analyses reports, detailed load specifications, design compliance matrix, etc.;
- Signature of three engineering service contracts (OMF-331-01-01-02/03, OMF-331-02-01-02) for (i) Sensitivity analyses on operating conditions for TBMs design; (ii) Finalisation of the TBM Conceptual Design and preparation of Conceptual Design Review Documentation; (iii) Preliminary design of the Neutron Activation System for the TBMs;
- Signature of a framework contract for technical and regulation assistance services on Nuclear Pressure Equipment (NPE) for the TBM Systems;
- Completion of seven engineering service contracts (OMF-331-01-01/02/03, OMF-331-02-01/02, OMF-331-03-01-01, OMF-331-05-01-01) aimed at finalising the activities for the conceptual design of the TBM Systems, the associated nuclear maintenance and the mounting sequence of the TBM box;
- Signature of four grants (FPA-372-02, FPA-380-1-01, GRT-542, FPA-380-3-01) for (i) Experimental activities in support of the design of HCLL and HCPB TBSs: liquid metal system and hydrogen/metal interfaces; (ii) Experimental activities in support of the design of HCLL and HCPB-TBS using the TBM-CA experimental facilities; (iii) Upgrade of the tritium transport modelling tool based on the EcosimPro simulation platform; (iv) Qualification of functional materials for test blanket module applications;
- Completion of two service contracts (OPE-305-01/02) for the standardisation of fabrication procedures for two sub-components of the TBM box: HCLL cooling plate and HCLL/HCPB stiffening plate. Other related contracts (OPE-305-03/04) have also progressed successfully (HCPB cooling plate, HCLL/HCPB first wall and side caps).

Progress Report

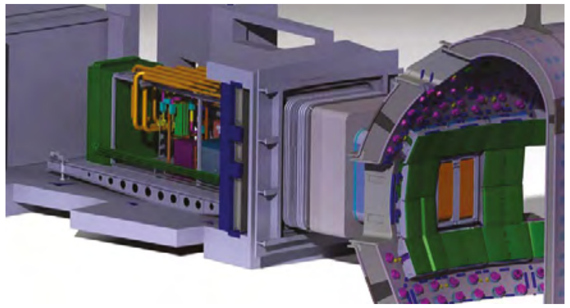
Signature of two TBM Arrangements with ITER IO

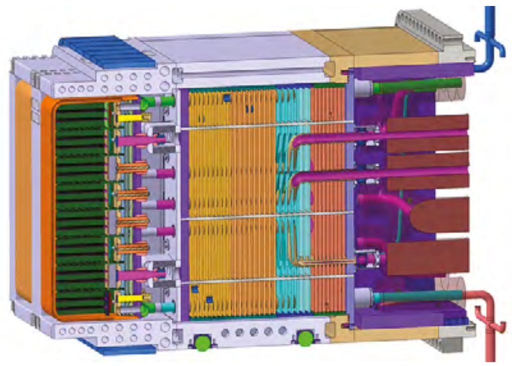
Two Arrangements between F4E and ITER IO, so-called TBM-Arrangements, have been signed in 2014. Through the TBM Arrangements, Euratom, represented by F4E, committed to deliver two TBM Systems and associated equipment/tools to the ITER site in a timely manner. ITER IO committed to prepare all necessary interfaces to host and operate the TBM System. Europe will remain the owner of the TBM System and related technological developments, and will be responsible of the corresponding generated rad-waste.

Progress in the Design of the TBM Systems

In 2014, the design and technical activities for the preparation of the Conceptual Design Review (CDR) for the two European TBM Systems (two TBMs, two radiation shields and seven ancillary systems) have been achieved. The CDR will be held in 2015. In 2014, design activities have reached the following milestones:

- The TBM systems design documentation for the CDR has been finalised; including functional analyses, systems design description, load specifications, design compliance matrix, etc.;
- The design of the steel structure of both TBMs has been homogenised leading to the adoption of a common design for both TBM back Helium manifold systems, for both TBM back radiation shields and for the TBM-Shield attachment system. These design commonalities are aimed at optimising future R&D and licensing costs. A full set of thermo-mechanical analyses has been run and verified against design limits of the nuclear construction code RCC-MRx. This has allowed F4E to build not only the first version of a justification file for the operation of TBMs under normal conditions, but also F4E to identify an allowed operational domain around those conditions. Also, a complete set of nuclear analyses using the ITER B-lite model have been carried out confirming the satisfactory performance of the shield and identifying possible further design improvements (OMF-331-01-01-01, IDOM/UNED);
- The conceptual design of the HCLL and HCPB Ancillary Systems has been finalised. All technologies for the seven ancillary systems (cooling, purification, tritium processing) have been selected and their main components sized. Stress analyses for piping and the most important components of each ancillary system have been carried out. Integration of systems in the Port Cell #16, in the Chemical and Volume Control System (CVCS) area and in the Tritium Process Room has been preliminarily carried out and will be consolidated in the next design phases. Already in the current layouts important safety requirements have been taken into account, such as the redundancy of the SIC-1 actuators/instrumentation and the implementation in the design of a pressure discharge vessel to manage accidents due to over-pressurisation of the loops. Specific technological developments have also been realised including the design of a Pb-16Li purification system with consecutive flow passes in concentric partitions that allows collection of impurities at the liquid top surface of the component (OMF-331-02-01-01, ENEA/KIT);
- A critical review of the F4E strategy for the export of irradiated TBMs has been carried out. It confirmed that the strategy envisaged by F4E for exporting irradiated TBMs or samples in view of Post Irradiation Examination in European Facilities is consistent and technologically feasible (OMF-331-03-01-01, AMEC);
- Regarding nuclear maintenance, a preliminary analysis of the maintainability of the Ancillary Equipment Unit (AEU) in the ITER Port Cell #16 has been carried out. Design modifications needed to execute/facilitate the implementation of short term maintenance tasks have been identified, particularly on components with the highest expected failure rate (filters, heating wires, valves, instrumentation) (OMF-331-03-01-01, AMEC);
- A framework contract has been signed with an Agreed Notified Body for providing technical and regulatory assistance services for Nuclear Pressure Equipment (NPE) required for the TBM Systems. Future task orders will help F4E to consolidate its strategy in the area of categorisation of NPE equipment, maintenance/inspection and qualification of fabrication procedures for TBM Systems. (OMF-545-01, APAVE; OMF-545-02, Bureau-Veritas).





(Top) Two European Test Blanket Modules installed in ITER port extension #16 and ancillary equipment unit in port cell behind and (Bottom) TBMs and radiation shields installed in the port plug frame

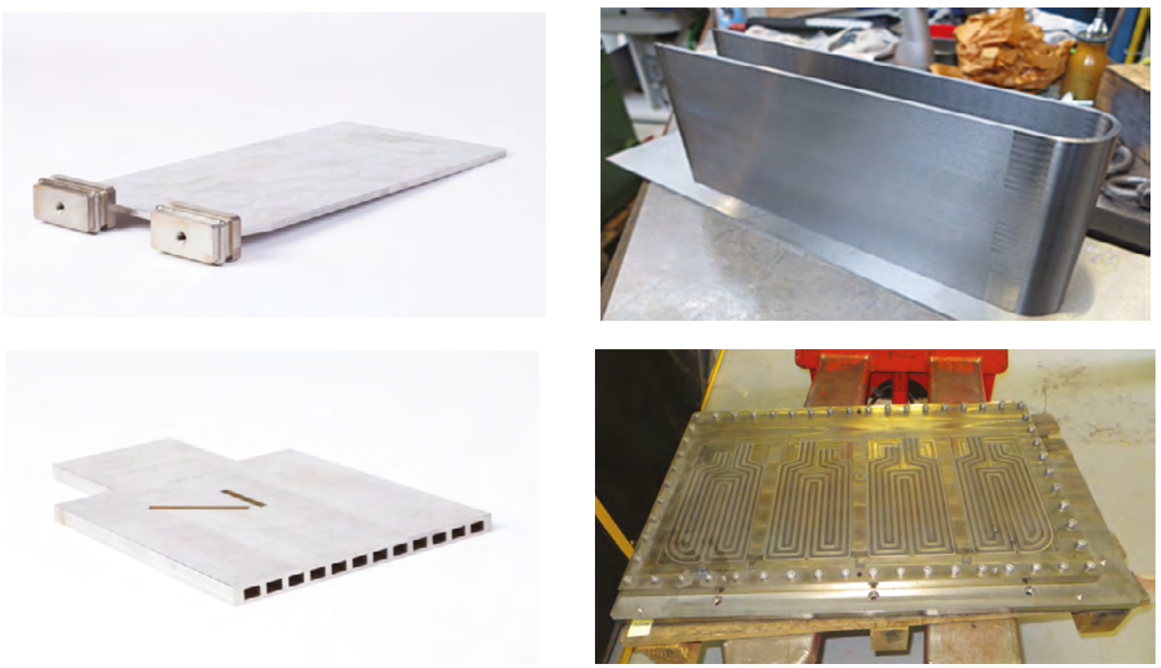
Standardisation of TBMs box fabrication procedures – Qualification of EUROFER-97 structural material

- The fabrication of standardised and near full-size mocks for three TBM sub-components (cooling plates, stiffening plates, side cap) was achieved successfully by industry (ATMOSTAT) and EFLs (CEA, KIT). A standardised 1/3 mock-up of the TBM first wall and side caps assembled together will be achieved in 2015. F4E is the owner of standardized welding procedure specifications developed for these mock-ups and to be used for the fabrication and licensing of TBMs for ITER (OPE-305-1/2/3/4). For the assembly of TBM structures by welding, two mounting sequences have been selected with industry and will be detailed and standardised in 2015-16 (OMF-331-05-01-01, ATMOSTAT);

- Concerning the qualification of the TBM structural material, the EUROFER-97 steel, efforts were focused on the development of the European database for Reduced-Activation Ferritic Martensitic Steels and on the preparation of documented ‘Modification Requests’ to be delivered to AFCEN for an extension of the EUROFER Appendix in the next edition 2015 of the nuclear construction code RCC-MRx (GRT-410);

- A systematic and exhaustive gap analysis of EUROFER-97 properties available in the European Database against requirements of the construction code RCC-MRx has also been carried out. It allowed F4E establishing a detailed irradiation matrix to be executed within two framework contracts signed in 2014 with Studsvik/INR for the completion of mechanical properties of irradiated (low dose) EUROFER-97 (OFC-413-03/04);

- In parallel, the overall strategy and methodology for development of specific EUROFER-97 design rules has been built in collaboration with EUROFUSION. It resulted in the launching of a call for proposals for the development of specific design rules for EUROFER-97 components. Corresponding activities will start in 2015 (FPA-603-01/02).



Full-scale or near full-scale mock-ups of TBM sub-components realised with standardised welding procedure specifications: (Top left) HCLL cooling plate; full size (ATMOSTAT/CEA); (Top right) HCPB cooling plate; full-size (KIT); (Bottom right) TBM Box Side Cap; half-size (ATMOSTAT/CEA). Meandering channels for heat extraction in their thickness are constructed by mixed laser/diffusion-bonding or spark erosion/bending processes; tolerances achieved are the reference ones for TBMs.

Associated Research & Development

In the area of R&D associated to the development of TBM Systems, the following activities have been carried out in 2014:

- A tritium transport simulation tool, based on EcosimPRO object-oriented modelling platform, was successfully developed in the frame of a grant action (GRT-254, CIEMAT/EAS). In 2014, tritium transport modelling activities in TBM systems were pursued (GRT-542, EAS). A call for proposal has also been launched for a framework partnership agreement aimed at developing simulation tools for the exploitation of TBM systems operation results in ITER, in particular in the area of i) thermo-hydraulics/MHD/chemistry of Pb-16Li; ii) tritium transport in solid, liquid, gases and iii) thermo-hydraulic analysis of helium (FPA-611-01/02);

- A specific grant has been signed with KIT and associated European Fusion Laboratories for experimental activities in support TBM Systems, in the area of liquid metal system and H/metal interfaces (FPA-372-02, TBM Consortium of Associates);

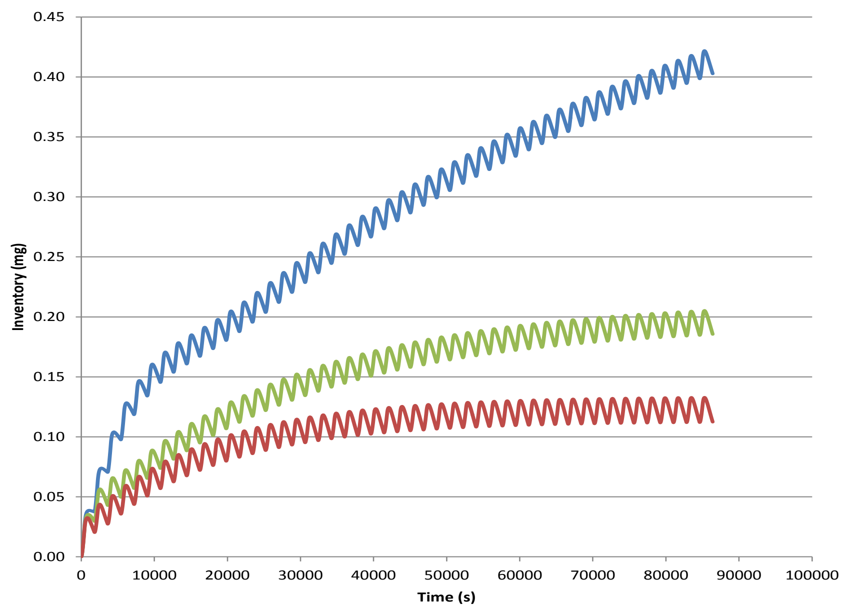
- The first specific grant for the Qualification of TBM Functional Materials with KIT and NRG has started. This action focuses on Post Irradiation Experiments of former irradiation campaigns of Be and ceramic pebbles for TBM/Breeding Blanket application, design of next irradiation experiments and update of the Functional Materials Database (F4E-FPA-380-3-01, TBM Consortium of Associates);

- First experiments for sizing and verification of the performance of key components of TBM Ancillary Systems have been achieved (Helium turbo-circulators operating in parallel, etc.) (FPA-372-01, FPA-380-1-01, TBM Consortium of Associates).

Safety and accidental analyses

- The HCLL and HCPB TBS Preliminary Safety Reports (PrSR) that were deeply revised in 2013-14 have been approved by ITER IO in 2014;

- A specific contract (F4E-OMF-331-04-01-01, AMEC) has started on the HCLL and HCPB TBS Models Development and Qualification and execution of the first set of Accident Analyses. The HCLL and HCPB TBS Accident Analyses specification has been released. MELCOR and RELAP5 generic models of the TBM Systems have been developed and extensively qualified against final element analyses, test cases and code-to-code comparison. The modelling of six accidental scenarios has started.



Simulation by EcosimPRO-based tool: tritium inventory in the HCLL-TBM box as a function of Pb-16Li flow-rate for back to back inductive plasma pulses over three daily shifts (tritium generation rate: 11 mg/d)

Technical Support Activities

Introduction

In carrying out its tasks, F4E also performs a number of technical activities which support the ITER project work and cover the following areas:

- Safety and Licensing;
- Analysis and Codes;
- Materials and Fabrication;
- Instrumentation and Control;
- Metrology;
- Drawing office;
- Plasma engineering.

Safety and Licensing

Safety is a top priority for the ITER Project and F4E as its major contributor for in-kind contributions and efforts are needed to ensure compliance with demanding nuclear safety regulations.

This strong commitment brought together more than 100 specialists from F4E and the ITER IO on 29-30 January 2014 to an event organised by F4E to discuss the current state of play, draw lessons from previous projects and highlight good practice that will be of value to ITER. The event was structured along plenary and thematic sessions, giving the opportunity to different teams to discuss the latest French and international nuclear regulation applying to the manufacturing of ITER components. The event was deemed to be a success and F4E senior managers noted the importance of instilling a rigorous nuclear safety culture and encouraged all participants to learn from the valuable observations made by the French Safety Authority (ASN), linked to the inspections on the ITER construction site and the manufacturing facilities.

Training courses on Quality Assurance, and Nuclear Safety have been given during 2014 internally and externally to more than 100 F4E staff, and more than 100 technical and management staff of F4E's suppliers involved in the construction of ITER.

F4E safety officers have been employed to assess PA input documentation, F4E management and technical specifications and design documents to ensure that the nuclear safety requirements are incorporated into the designs and that the evidence to demonstrate those safety requirements is also identified. A nuclear safety review has been carried out on all deviation requests and non-conformities of the Protection Important Components (PIC) and Defined or Safety Requirements for each package coming from ITER IO (which is the Nuclear Operator)

F4E's safety officers have directly participated in the following ITER IO/F4E study groups: Port Cell Design Optimisation, Post-Fukishima Stress Test.

F4E's safety officers have participated in the contracts to design and construct various F4E systems and components for ITER with Protection Important Component (PIC) classification. This includes the documentation to demonstrate that protection requirements are met, the propagation of protection requirements in the sub-contracting lists, the witnessing of protection important activities and the overseeing of the preparation and delivery of the documents for the Nuclear Safety File. Examples include the prototype cryopump for the vacuum vessel and the WDS tanks which will be delivered in early 2015. These will be the first components built according the nuclear QA rules delivered by F4E to the ITER IO.

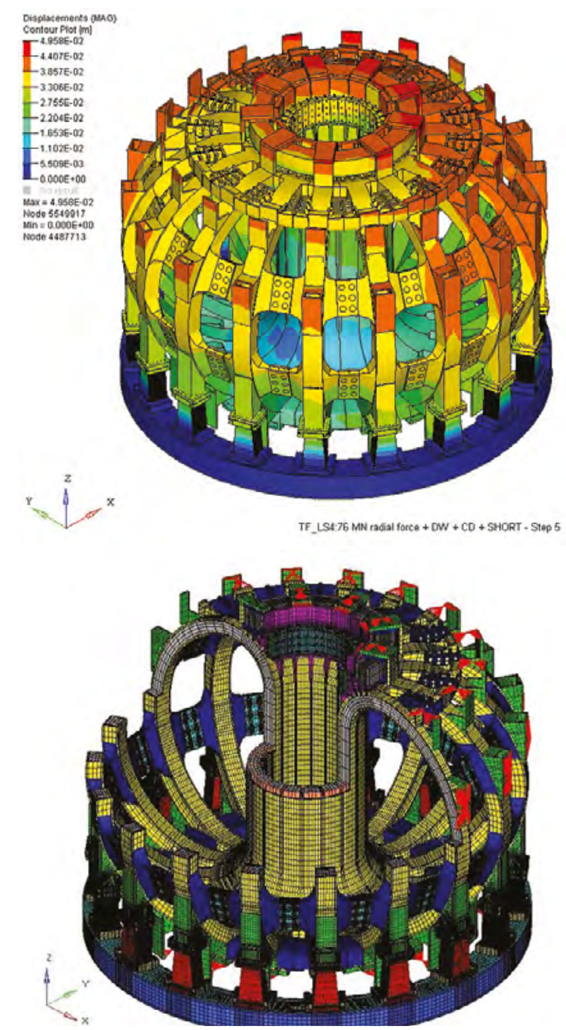
On a more specific level the French Safety Authorities (ASN) performed several in-situ inspections at the site of the construction of the Tokamak building at Cadarache and in other DAs. Based on the lessons learned out of the inspections F4E has reviewed their processes in order to better follow up the safety requirements and the non-conformity requests from the supplier according to the French INB Order of 07/02/2012.

F4E also managed the workshop about fusion in the most important nuclear conference for young professionals, the International Youth Nuclear Congress (IYNC) 2014. Lectures about fusion nuclear safety have also been given at UPC Barcelona, KIT Karlsruhe at the Plasma Summer School and PQM-NET: IST-1 at IPFN Lisboa.

Analysis and Codes

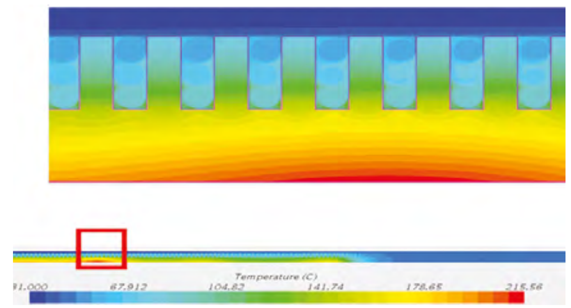
The activities focused on providing technical support in the area of computational analysis to the development of the ITER design as well as to the F4E procurement contracts by placing and following up service contracts to qualified companies as well as internal analysis activity.

Regarding mechanical analyses, several studies were obtained from European industries to support the manufacturing of the vacuum vessel, first wall panels, etc. In addition to these tasks, a structural analysis of the whole TF coil magnet system (i.e. 360 degrees, 18 TF coils) under faulted conditions was performed to verify the strength of the TF structures to avoid damage to the vacuum vessel (primary containment) under faulted conditions. Two possible electrical failure of one TF coil were considered, i.e. the loss of cyclic symmetry in TF coil currents, due to a short and a quench in a TF coil without discharge. The results show that the TF coil structure is capable of avoiding damage to the primary confinement and that no major damage is expected to occur to the TF magnet system itself.



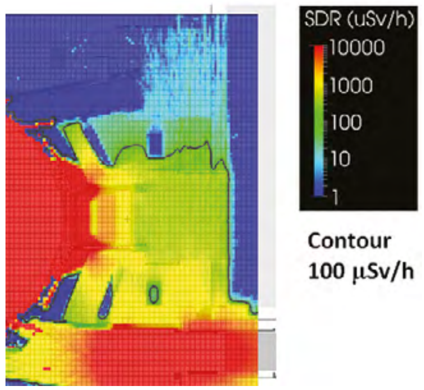
Displacements field contour plot (m) (with amplification factor of 10) for a load case corresponding to 76 MN pre-tension on the pre-compression ring, dead weight and after cool-down due to a single TF coil short

In the area of the fluid dynamic analyses several contracts have been launched. Among them it is worth mentioning a task on the thermo-hydraulic optimisation of the gyrotron collector that involves the computation of bi-phase fluid. In the figure below the temperature field in both solid and fluid regions of the gyrotron collector is shown and in the inset a zoom of the region where the load peak is located. These findings are in line with the predictions and confirm the efficiency of the optimised design in terms of heat removal.



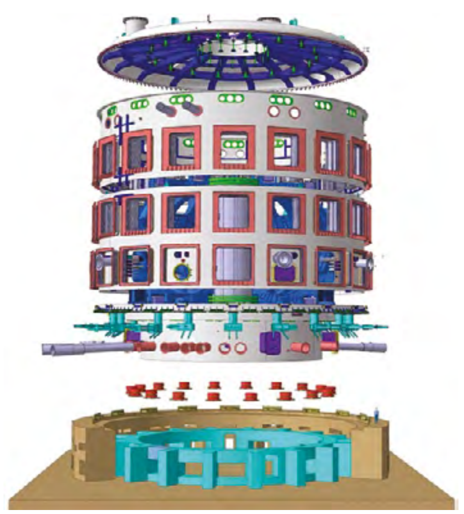
Gyrotron collector temperature map in the solid and fluid regions

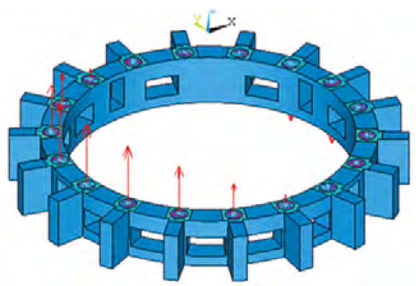
In the area of nuclear analyses, the performance of cryo-pump lower port shielding options to reduce dose rates in equatorial port interspaces has been investigated. Preliminary shielding assessments for heavy nuclear doors in the tokamak building have been performed and highlight the need for faithful design models and properly validated computational methods. Support to improve the analysis results for Toroidal Field Coils (TFC) nuclear heating was provided via the Neutronics Task Force, in particular the detailed model of the TFC inboard straight leg. Shutdown dose rate field (12 days after shutdown, see figure) due to activation of lower and equatorial port region. The study of tritium transients in the tritium plant and the thermal hydraulic performance of the vacuum vessel and first wall were the most challenging studies carried out so far in F4E in the field of computational fluid dynamics. Within the nuclear data project, aiming at the improvement and validation of the nuclear data base for ITER, DEMO and IFMIF, several important contributions were provided, such as new high quality transport data evaluations for Copper, verification and validation of a standard EU activation library (TENDL) and assembly of an integral validation experiment on Cu.

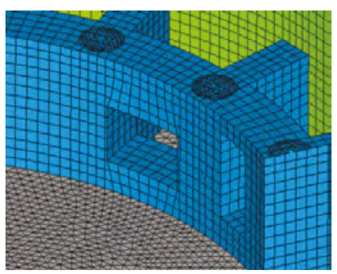


Shutdown dose rate in the equatorial port interspace after 12 days from shutdown

Moreover, support to the architect engineer and ITER IO building team, was provided through several detailed structural analyses and supported the release of the ASN's Hold Point for the construction of the B2 basemat. In-house calculation models have been developed to support the justification of the design and the hypothesis considered by the Architect Engineer and ITER IO (load distribution from the machine).







Reinforced concrete crown with the 18 sliding bearings supporting the Tokamak machine and its modelling

Materials and Fabrication

The 2014 activities in this area included characterisation and assessment of materials data under ITER operational conditions via irradiation campaigns, testing at cryogenic, room and elevated temperatures, thermal fatigue testing, assessment of corrosion parameters and development of welding technologies. Assessments of materials data were performed by non-destructive testing, mechanical and physical characterisation of materials and joints. The activities were linked with R&D, qualification and validation of series production stages of various EU-ITER and JT-60SA subsystems. As several ITER systems entered manufacturing phase during 2014, there was a significant increase in the materials follow-up support for different areas of F4E's ITER in-kind contributions.

Figure: Sample material made out of austenitic stainless steel by additive manufacturing by Mid-Sweden University, Sweden, to be characterised by Tecnalia, Spain

One new task in 2014 concerned the additive manufacturing technology (commonly referred to as "3D printing") for the construction of near net-shape components in austenitic stainless steel and was initiated with Stockholm University and Mid-Sweden University, Sweden. The technology is booming worldwide and it was considered to be an important area to explore as a strategic option for fabrication of complex pieces. Austenitic stainless steel is one of the main materials within ITER and the First Wall Panel Beam was selected as the pilot application. The first trials were successful and the material is being fully characterised by Tecnalia, Spain, in order to verify its properties against the stringent ITER material requirements.

Instrumentation and Control - CODAC

During 2014, support was provided to several areas of F4E's ITER work on Instrumentation and Control (I&C) areas. According to the strategy and maturity of each ITER plant system this included requirements management and formalisation, participation and organisation of design reviews, review of design documents from plant system suppliers and selection process. Areas that were supported include buildings and electrical distribution, the cryoplant, TBMs, radiation monitoring, Remote Handling, Diagnostics, Electro-Cyclotron and Neutral Beam heating.

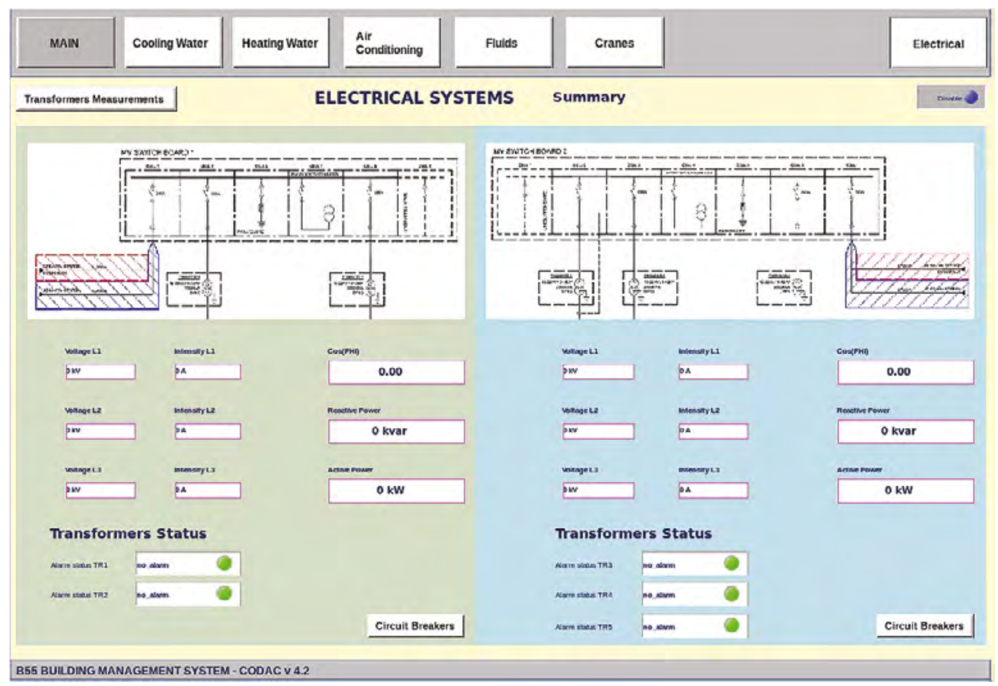
The specific support to F4E Project Teams which aimed to foster a common approach for the integration of plant systems into ITER central I&C Systems, in discussion and consensus with ITER groups was performed through the two following framework contracts.

- An in-sourcing contract, awarded to INDRA, is used to provide Instrumentation and Control specialised system and electronic engineering support to F4E project teams. During 2014, around 1,000 days of support were distributed.
- The system integrator framework contract, awarded to GTD systems, was used to provide system support on design, prototyping and implementation of I&C systems. During 2014, four main tasks have been started:
  - o Design of the Integration of EU cryoplant into CODAC central systems
  - o Advanced conceptual design of the magnetics diagnostic plant system controller hardware and software
  - o Development plan for the GENROBOT (generic robotics controller integrated in the Remote Handling plant system.) project
  - o Fast plant controller prototype

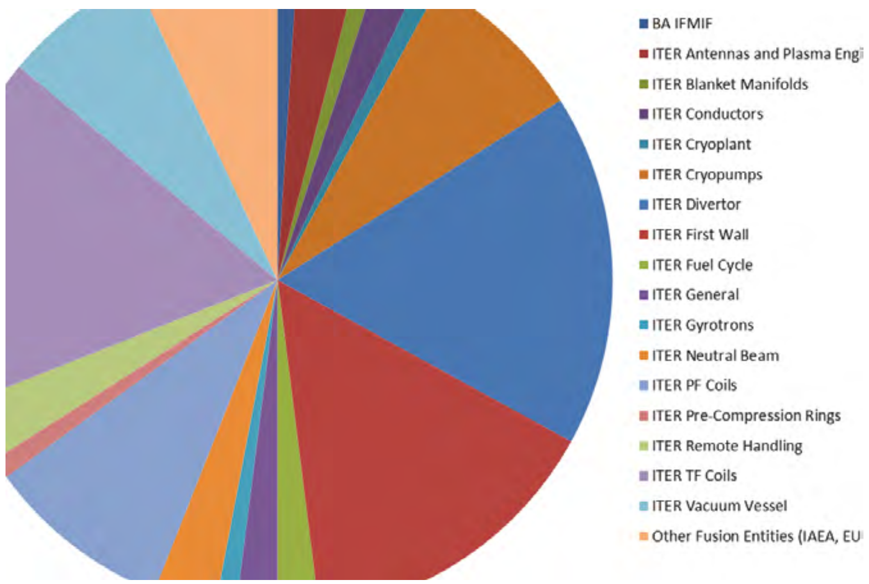
This is worth highlighting the following significant contributions in the area of CODAC during 2014:

- o Building B55 HMI Upgrade

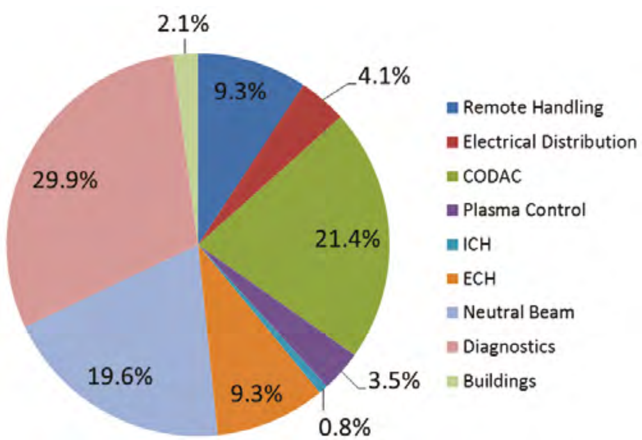
A proposal has been made by ITER IO CODAC to display the Epics HMI of the B55 BMS in the main entrance of ITER as an example of CODAC development. For this exercise a general re-engineering was necessary in order to make the HMI more consistent with the local HMI developed by Omega in 2011.



One of the HMI screens re-engineering for the B55 BMS display in ITER Main Entrance
This activity was completed by INDRA in collaboration with IO CODAC



The distribution of work of F4E's Materials and Fabrication Group per entity, where the main work for the year 2014 was in support of the in-vessel components, magnets and vacuum vessel

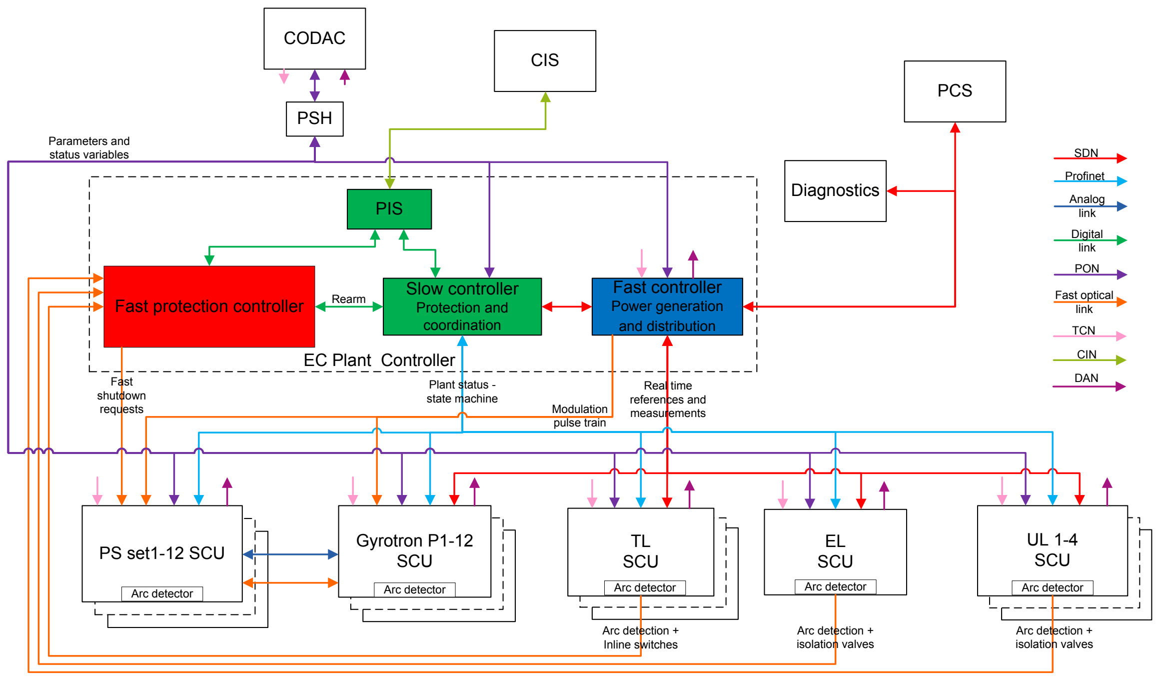


Distribution of effort by INDRA during 2014

- o Progress in the design of the Plant Controller and participation to the first EC Control System workshop

The Electron Cyclotron heating system is a first plasma system and essential for breakdown as well as for advanced plasma scenarios. It is a complex system due to the number of subsystems involved and for the procurement strategy which split among five different DAs.

The F4E CODAC team collaborates with different F4E Project Teams in the design of most of the EC subsystems (i.e. power supplies, gyrotrons and launchers) and of the EC plant controller, which supervises the whole system and interfaces with the ITER Central I&C. In this context, a significant contribution has been to promote among the involved DAs a system engineering culture providing examples and templates for the risk analysis of the EC subsystems. The protection functions for the plant controller and the European gyrotrons were presented to the EC control system workshop held in July at the ITER IO. The tables used to describe the faults have become a template for the analyses done by the other DAs for their subsystems. The progress in the design of the plant controller has also been presented during the workshop since it further defines and constrains the interfaces of the EC subsystems.



EC Control System architecture

Other activities of the CODAC team in the EC project concerns the support in the design of the European power supplies, whose FDR was successfully passed and the preparation of the procurement arrangement for the EC Plant Controller, signed in December 2014.

- o Magnetic diagnostics advanced CDR

More than two years have been spent to clarify the requirements and identify the correct development path in collaboration the ITER counterparts.

At the end of 2014 it was finally possible to organise a CDR for the plant controller and the signal integrators components of the magnetic diagnostics. The first review targeted the design of the signal integrator. This component is essential to convert the electrical signals produced by the Mirnov coils into a signal proportional to the magnetic field in the Tokamak. Designing integrators for ITER is a challenge because of the duration of the experiment (~1 hour) and because of the large signals produced by the diagnostic coils. A lot of work was also necessary to better understand the project needs so that to be finally able to tune down the integrator requirements towards something more feasible.

During the design review, the tests of the current most advanced design for an integrator were presented showing that the current state of the art is sufficiently close to the final objective and that achieving the final goal is possible even though very challenging.

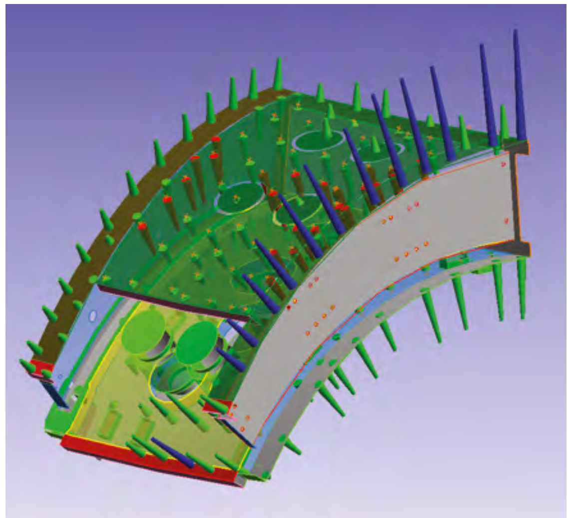
The second review targeted the design of the overall control systems. The main objectives were to clearly identify the overall set of functions that the system had to perform. Especially challenging was to clarify the interface with the interlock system.

Different design solutions have been presented, but the most promising identifies three main components for the plant controller. The mustering of all the digital information and its distribution to both SDN (real time network) and interlock system is performed by off the shelf FPGA cards with custom firmware (DSP in the figure). The hosting of the signal integrator is performed by custom design cards which individually connect to the FPGA boards. Finally the advanced processing of magnetic information is performed by standard processor systems connected to the real time network (both interlock and conventional).

Metrology

Factory acceptance tests as well as intermediate process geometry assessment is a key phase in the development of components that have to be delivered to the ITER site. In particular the check of mechanical interfaces between adjacent components is very important to allow a smooth assembly process into the ITER machine. In this frame the Metrology Team gives transversal support to all F4E Project Teams in the field of metrology, geometrical survey and procedure development.

It is worth highlighting the work performed in 2014 to check the final geometry of the Vacuum Vessel PS1 and PS2 mock-ups. Metrology played an important role in the fabrication process that started with the discussion of high level metrology requirements according the F4E Metrology Handbook QA -117 and ended up with the geometrical check of the fabricated mock-up. After the documentation checks, PS1 and PS2-UP mock-ups surveys have been carried out by Setis-PES consortium under F4E's supervision. Some critical measurements have been double-checked by F4E which independently surveyed the components with proprietary instrumentation and software. The work carried out in close collaboration with F4E's contractor (AMW) provided evidence of some small geometrical discrepancies in the PS2-UP mock and larger differences for the PS1 mock up. On the basis of the data acquired, a fruitful discussion on the manufacturing strategy has been initiated which triggered a revision of the fit up alignment process and component survey.

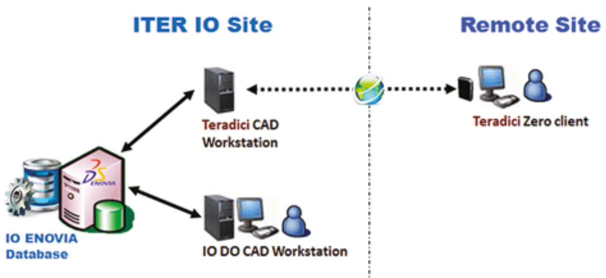


Results of VV PS2 geometrical survey

Metrology instrumentation

Drawing Office

During 2014, an important effort was made to deploy the collaborative design infrastructure between ITER IO, F4E and its suppliers. A synchronous scheme of design collaboration based on the Teradici remote display solution has been implemented to connect 20 companies/institutes to the ITER ENOVIA database in Cadarache. More than 60 designers were trained and certified by F4E's Drawing Office (DO) on specific ITER IO CAD methodologies.

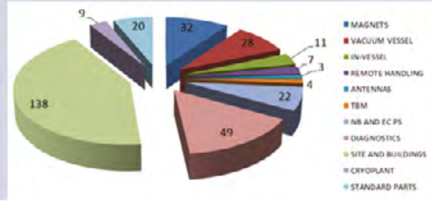


It is also worth mentioning the support provided by the F4E DO in setting up the collaborative environment for the creation of diagrams PFD and P&ID. More than 20 designers have been trained on See System Design methodologies.

Among all the tasks in support to the F4E Project teams, one of the key activities is related to the management of all the CAD data exchanged between ITER IO, F4E and F4E suppliers. The exchange of CAD data is based on the ITER DET procedure.

323 DETs processed 2014

Project Team		Project Team	
MAGNETS	32	TBM	4
VACUUM VESEEL	28	NB AND EC PS	22
IN-VESSEL	11	DIAGNOSTICS	49
REMOTE HANDLING	7	SITE AND BUILDINGS	138
ANTENNAS	3	CRYOPLANT	9
STANDARD PARTS	20		



Number of DETs processed by the F4E DO in 2014

Finally, this is important to highlight that an engineering data management system based on Enovia SmarTeam has been developed, providing tools to manage the DETs in a more reliable way, and allowing the members of the Project Teams to access the CAD data easily for viewing or checking purposes.

Plasma Engineering

Part of F4E Plasma Engineering (PE) activities are carried out in support to EU procurements and part on the basis of ITER Task Agreements (ITAs), awarded, as the result of competition between DAs or on the basis of specific competence.

In 2014 ITA C19TD52FE was assigned to F4E, requesting the study of energy loads and their mitigation during disruptions and runaway electron formation in ITER.

In 2014 a large part of the activity consisted in the follow up of existing grants and contracts: GRT-502, GRT-519, GRT-346, GRT 379, GRT 397, OPE-501, OPE-505.

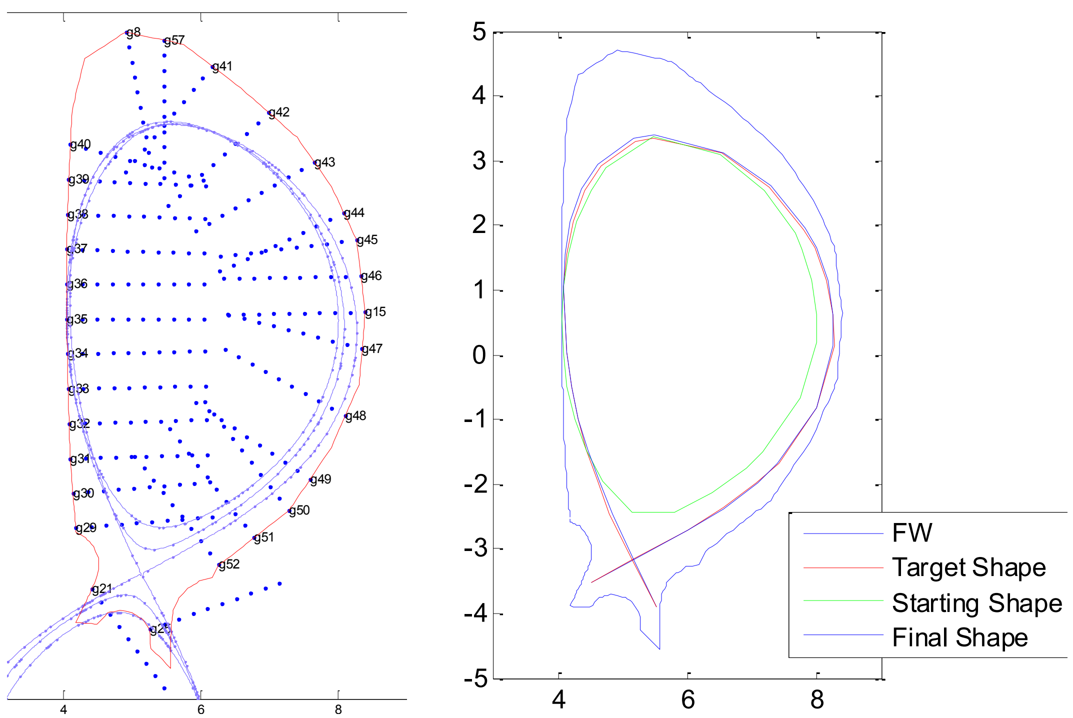
In the field of PE, F4E awarded two contracts in 2014: OPE-541 for the integration of the GRAY code in the simulation suite JINTRAC and OPE-584 for the study of energy loads and their mitigation during disruptions and runaway electron formation in ITER.

The implementation of the above grants and contracts involves several european fusion laboratories (Aalto Uni, CEA, ENEA, CCFE, CNR, KIT, Austrian Association, CRPP and IPP).

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

Progress Report

An important activity in 2014 was the development of a realistic control system for the ITER pulse. The design of the control system, carried out under GRT-519, comprises all phases of the discharge: for each phase an analysis was carried out to establish the most suitable control strategy, taking in consideration also magnetic diagnostic issues. The design includes the management of transitions between different controllers and the application of feed-forward actions triggered by fast plasma transients. The control strategy developed foresees three different controllers along the pulse: a simple plasma centroid position controller for Ip below 3 MA, an isoflux controller for Ip>3 MA and up to the transition to divertor and an XSC like controller for the diverted plasma phase.

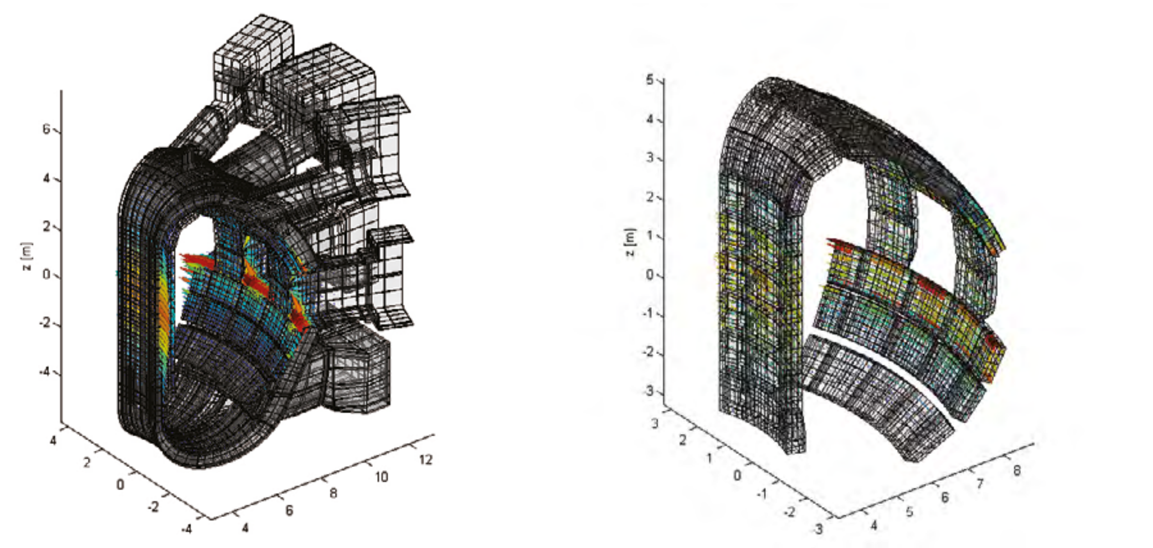


Reference shape parameters and shape evolution for the isoflux controller in scenario 1

A second successful activity is a spin off an F4E task in response to a STAC charge requesting a detailed analysis of the impact of removing the copper cladding on the Outer Toroidal Ring and consists in the development of a code able to couple a 2D model of the plasma dynamic to a 3D model of the passive structures able to include also halo currents flowing from the plasma to the structures. The study of transients with such tool has allowed computing the contribution of 3D currents flowing in blanket modules on plasma stability.

Other activities in the area of plasma engineering in 2014 included support to the EU members of the ITER Science and Technology Advisory Committee (STAC) and to the Technical Advisory Panel of F4E.

Some activities foreseen in F4E's 2014 Work Programme were cancelled because the related ITAs were not issued by the ITER IO (in particular on plasma control) and other activities were postponed due budget constraints of the ITER IO.

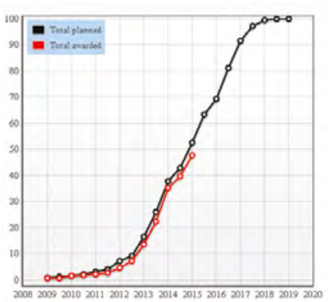


Pattern of currents flowing in Vessel and Blankets in response to an 0.2 li drop @ Ip=15MA

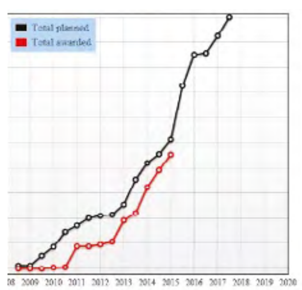
Broader Approach

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.

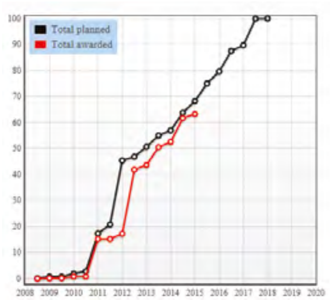
	JT-60SA (STP)	IFMIF/EVEDA	IFERC	BA
End December 2013 Earned/planned credit	91.3%	78.1%	98.3%	91.1%
End December 2014 Earned/planned credit	85.2%	83,2%	97.8%	89.7%



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 years

For JT-60SA, the baseline for the above earned value covers at present 93% of the project credit for components and assembly. For IFMIF/EVEDA the corresponding figures are 98% and 92% respectively.

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

Considerable progress was made with the manufacture of the TF coils, although delays have occurred due to problems with the casing manufacture. The cryoplant was manufactured and tested, and readied for shipment. The quench protection system was tested and transported to Japan, and installation began. Work on the other magnet power supplies, current leads, and cryostat vessel body is also proceeding well.

Toroidal Field Coils

F4E is procuring 27 km of toroidal field conductor, a cable-in-conduit type conductor with 486 strands (2/3 NbTi - 1/3 copper) embedded in a rectangular stainless steel jacket. The strand contract with Furukawa was completed in 2013. The full set of cables necessary for the fabrication of the 18 coils was produced by ICAS. 99 (out of 115) complete conductors were also produced and tested, with 76 already delivered to the TF coil manufacturers. These are ALTHOM and ASG, under contract since 2011 to CEA and ENEA. During 2014, the first TF winding packs (WPs) were completed by both manufacturers. For each, a set of six double pancakes was wound, fitted with ground insulation, vacuum impregnated and subjected to acceptance tests. Both manufacturers achieved the impregnation of the first coil by the end of 2014.

The contract for TF coil casing manufacture was placed by ENEA with Walter Tosto (WTO) in 2012. Problems arose due to the quality of the forged materials for the casing elbows. This was solved in May 2014 by the F4E procurement of new forgings. Nine deliveries were shipped to WTO, and the additional tests made by F4E in collaboration with JAEA, qualified the material. While waiting, WTO rearranged the manufacturing schedule, anticipating, as far as possible, the fabrication of the remaining parts. Additional difficulties were faced and solved regarding the welding process for the elbow halves. Deformation of the structure during machining (in spite of stress-relief treatments performed) forced the supplier to proceed with extra care to avoid exceeding tolerances in an unrecoverable way. This led to a doubling of the machining steps and, in spite of the (provisional) parallel use of two large milling machines, the schedule has been further delayed.

The TF coils assembly guide, providing the information needed by JAEA in order to successfully install the TF coils in the JT-60SA torus hall, has been prepared and discussed with JAEA. It describes the condition of the components when received by JAEA, the tolerances assumed, the use of adjustable features provided, and technical precautions required.

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 m long, 1.8 m 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. A one-third mockup of a full-size OIS was completed in the

Coil no. 10 extraction from the impregnation mould at ALSTOM

Winding Pack no. 1 (WP-01) placed on the tooling for case insertion at ASG autumn. Improvements were made to the design of the welds and the welding procedures, in particular to manage deformations, and extensive cryogenic toughness testing was performed on the material, welds and heat affected zones. Fabrication of the first complete OIS began in July 2014. 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. Almost all the parts are now machined. Some problems were encountered and overcome with the qualification of welds needed for the legs. All the GSs will be completed well in advance of their being needed. The full schedule of delivery of the OIS and of the GS was modified as a consequence in the new pre-assembly strategy (pre-assembly of OIS performed in CEA-Saclay, not in Japan).

CEA Saclay completed the installation of the TF coils cold test facility. The valve box, the main interface between the helium refrigerator and the test cryostat, was assembled and tested. The power supplies were upgraded to provide the nominal current of 25.7 kA for the coil test. A temporary magnet safety system (MSS) was installed and tested at the power supply´s nominal current. The final version of the MSS was nearing completion by end-2014 and will be ready for the tests of the TF coils. At the end of 2014 the superconducting jumper was installed and cool-down started with some delay.

The 26 high temperature superconducting current leads (HTS CLs) which connect the superconducting feeders with the power supply busses are provided by KIT. The CuLTKa test facility was completed and successfully commissioned. The manufacture of the HTS CLs proceeded as planned. Manufacture of the six current leads for the TF coils was finished. The first two TF coil CLs were tested in CuLTKa with very good results (e.g. the electrical resistance at the cold connection between the current leads and the superconducting jumper was around 1 nΩ). The second pair of current leads began testing in December 2014. Manufacture of the PF coil CLs also made progress:. for six current leads out of the twenty, almost all parts were available and assembly started. The remaining fourteen current leads were in different stages of manufacture.

Magnet Power Supply Systems

The manufacturing (by NIdec ASI for CNR/Consorzio RFX) of the 13 quench protection circuit (QPC) units for the TF and PF coils, and factory tests on all QPC units, were successfully completed by the end of July. After packing of the units and preparation of final documentation, the QPCs were shipped from Genoa, Italy, in August and were delivered to Naka at the end of September. All the documentation needed for obtaining the authorisation to start the on-site activities, including safety plans, was prepared and approved. The QPC installation activities started in December 2014, and are proceeding according to schedule, leading to the completion of installation in the first quarter of 2015.

QPC components stored in the rectifier building

QPC on-site installation activities

The switching network units (SNUs) are being procured by Energy Technology - OCEM for ENEA. The first unit was completed in the first half of 2014. Type tests were successfully performed in September, including a set of tests on the complete assembly of the first SNU unit that was installed to perform the complete cycle test with nominal current and voltage.

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. To reduce impact on the schedule, the design of the SCMPS was divided into eight First Design Reports (FDR), allowing commencement of the related manufacturing phase after the approval of each single document. Procurement took place of critical components for the EF (equilibrium field coil) PS, and the assembly of the first EF PS units started in the second half of 2014. The transformers for the fast plasma position control coil (FPPCC) PSs were manufactured and successfully tested in June 2014. Manufacturing of the FPPCC PS converters was completed during the second half of 2014, ready for the test of FPPCC PSs in February 2015.

The resistive wall mode power supply (RWMPS) is to be supplied by CNR/Consorzio RFX. The manufacturing of a prototype inverter was completed in the first months of 2014, and the related tests, performed in May-June, fulfilled the main requirements, and were particularly demanding in terms of latency (<50μs) and current dynamics (3 kHz bandwidth). Taking advantage of experience gained, the Procurement Arrangement was readied for signature.

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). Pre-assembly and welding procedures were improved during manufacturing of the first three sectors to minimise welding deformation. The CVBCS PA, originally terminating in March 2015, was extended to March 2017.

Cryogenic System

The superconducting coils, thermal shields, HTSCLs and divertor cryopumps, which require refrigeration at 3.7 K to 100 K provided by a cryoplant with an equivalent refrigeration capacity of about 8 kW at 4.5 K, is being procured through a CEA contract with Air Liquide Advanced Technology (ALAT) signed in 2012.

Manufacture of all major components and subsystems was completed by autumn 2014. All components underwent comprehensive works testing before being released for shipment. All components were transported to the port of Antwerp, Belgium, for a combined transport to Japan in the middle of January 2015.

Refrigeration cold boxes (cold end) with insulated cold components

IFMIF/EVEDA Programme

F4E has worked with JAEA and the Project Team (PT) at Rokkasho to have all PAs agreed and signed. The signature process of AF12 – Cryoplant - is expected to be completed in March 2015. Several PAs which were bound to expire in 2014 were agreed to have a longer duration. Accordingly amendments to the PAs LF03, LF04, AF03-EU, AF08-EU, and AF09 were agreed and signed. Following a recommendation given by the BA Steering Committee, a new PA related to the PA AF03 was agreed and signed to provide a back-up set of RF couplers to the RF quadrupole.

Further management activities were shared and accomplished jointly with the PT and JAEA:

- Definition of roles and responsibilities (OBS) for the LIPAc installation and commissioning;
- Consolidation and updating of the LIPAc integrated master schedule (LIMS) (still in progress);
- Consolidation and execution of the earned value management (EVM) system to track and report the progress of the project.

On the technical front the main achievement has been the installation of the LIPAc injector in Rokkasho.

Main Technical Achievements

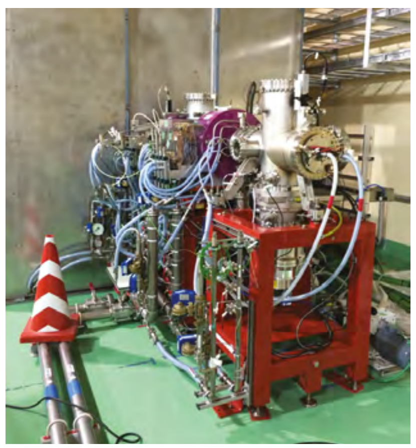
The installation phase of the LIPAc (Linear IFMIF Prototype Accelerator) injector was started in March and successfully concluded by the end of April. The subsequent injector check-out phase in September made use of the secondary cooling system and the electrical distribution boards set up by JAEA contractors. The following injector commissioning achieved its first plasma in the ionization chamber on 24 October 2014 and the first proton beam was extracted on 4 November 2014. The next steps will include deuteron beam generation.

Following the assembly of the first two high-power RF chains, and their acceptance tests, one module was successfully used to condition the prototypes of the SRF (superconducting RF) linac couplers at high power, thus paving the way for procurement of the couplers. The acceptance tests of two RF power systems for the RF quadrupole were successfully completed in Madrid, and shipment to Rokkasho is under preparation. Acceptance testing of the high power supermodule of the RF quadrupole was started at INFN Legnaro well on schedule for the expected delivery to Rokkasho by mid-2015.

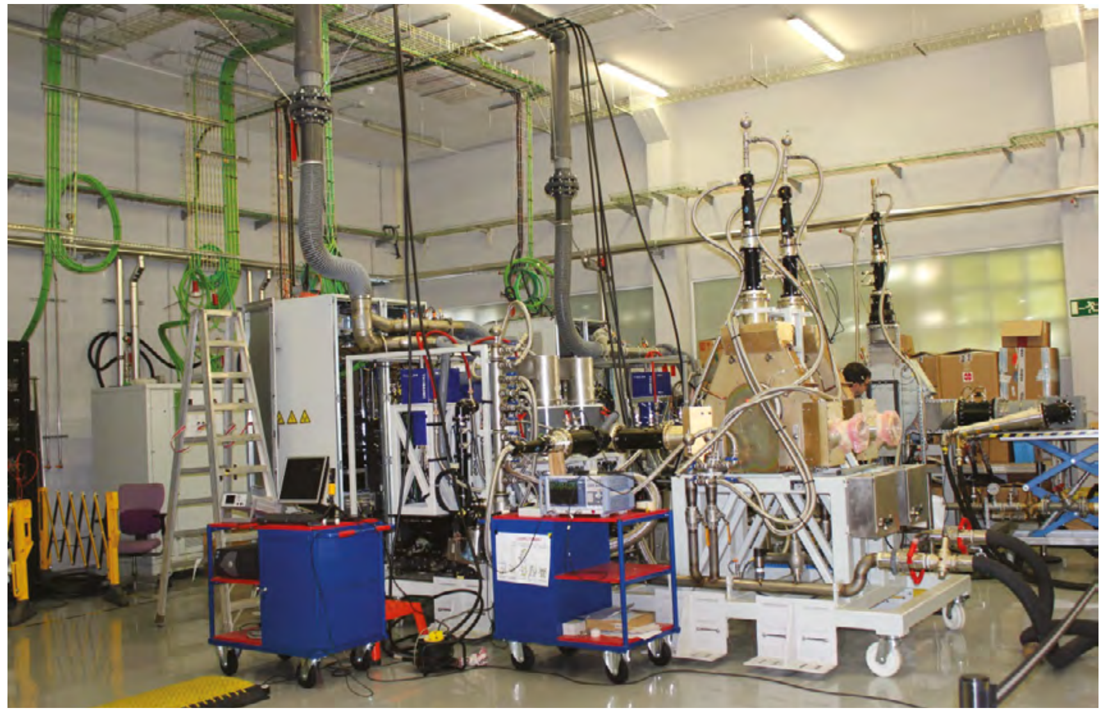
The PA AF09 for the LIPAc diagnostics was successfully completed after delivery of most components to Rokkasho, and of selected components to Madrid where they will be integrated in the accelerator system which will be delivered later to Rokkasho.

The second test campaign with the ENEA cavitation sensor has been conducted at the EVEDA Lithium Test Loop (ELTL) in Oarai, Japan, finalising the ENEA part of the cavitation studies and the related PA LF01-EU. The observed flow instabilities highlighted the need for a refinement of the geometrical arrangement of the metallic tubes below the target assembly to eliminate the erosion risk for a future lithium-based neutron source. Hot commissioning of the LIFUS6 loop at ENEA Brasimone started with circulating liquid lithium metal. This initiated erosion and corrosion studies of structural materials in contact with liquid lithium.

The BR2 irradiation tests of the prototypical capsules designed for high flux test modules was performed as planned over 3 cycles from July 2014 to December 2014. The general feasibility of the tight temperature control of the specimens was proven.



The injector of the LIPAc accelerator installed in Rokkasho



The RF power system for the RF quadrupole awaiting shipment to Rokkasho.

IFERC Programme

In 2014, the IFERC project:

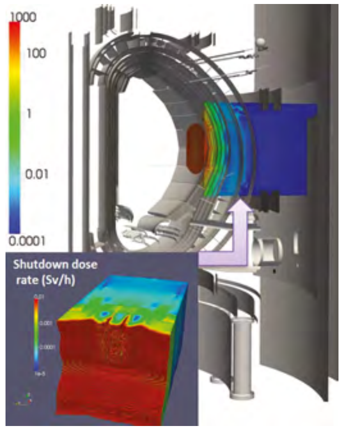
- Continued the successful operation of the Computational Simulation Centre (CSC), with two upgrades to the system;
- Continued the activities in DEMO R&D in materials and DEMO Design, increasing the interaction between the two areas;
- Started the implementation of the REC activities.

Computational Simulation Centre

In 2014 Helios (the supercomputer provided by CEA under a contract with Bull) entered its third year of exploitation, and completed its third cycle of computational projects. Bull continued to fulfil its contractual commitments for availability and performance of the system. Several important upgrades were made to Helios:

- In January 2014, an Intel Xeon Phi (MIC) extension to Helios was installed and opened to the users in February 2014. The “many-cores” architecture represents the “state of the art” in supercomputer processors, and the purpose of this extension is to encourage the fusion community to prepare the efficient and skilful passage to future machines. The peak performance of this new partition of Helios is 427 Tflops (225 Tflops Linpack). With 360 Intel Xeon Phi coprocessors, it is one of the largest configurations in the world;
- In summer 2014, an additional compute rack, similar to the racks already installed (Intel Xeon Sandy Bridge processors) was added to Helios. The number of nodes based on Intel Xeon processors increased from 4410 to 4500. With this second upgrade the total peak performance of Helios is very close to 2 Pflops;
- In November 2014, a major upgrade of the operating system of Helios was performed. This upgrade allows the use of Intel Xeon Phi coprocessors in “native” mode which will likely be the main mode of usage of future generation of MIC.

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



Map of total neutron flux with 3D visualisation of excessive neutron streaming for the ITER Diagnostics Generic Upper Port Plug (UPP), obtained with massively parallel MCNP5 calculations on Helios supercomputer for the MCHIFI and MCHIFI2 project. (MCHIFI and MCHIFI2, Arkady Serikov)

The fourth cycle of projects started in mid-November 2014 and will continue until mid-November 2015. Results of simulation projects carried out on Helios in the first and second cycles have been published in many scientific journals and presented at various conferences and meetings.

DEMO Materials R&D Programme

DEMO activities continued in 2014 as planned in the PAs. The 14th Workshop on DEMO R&D, held in February 2014 in Kyoto jointly with the 5th DEMO Design Activities Technical Coordination Meeting, reviewed design activities and plans.

In 2014, the results obtained in the joint DEMO Design Activities (DDA), started in 2010, have been summarised in an Intermediate Report. In Europe, the contribution to the DDA activities came from the EFDA associates and the collaboration continues now under the EUROfusion Work Packages. The emphasis in the first four years of work has been on identifying and analysing key design issues and R&D needs in the following areas: systems code and analysis of DEMO design points; physics design integration and scenario modelling; divertor and power exhaust; vessel and in-vessel components; remote maintenance; superconducting magnets; structural material design and R&D; safety. The effort on the DDA conducted so far has focussed on the identification of the DEMO pre-requisites, the main design and technical challenges (physics and technology), the identification and preliminary assessment of the foreseeable technical solutions, and the definition of the R&D needs. The main achievements include:

- Refinements and improvements to EU and JA system codes, in particular for the modelling of flux swing, bootstrap current, superconducting magnets, and plasma radiation; in addition the benchmarking work required the re-examination of basic assumptions about machine engineering, operation, and targets, which has helped to avoid misunderstandings in other areas of the work;
- Analysis of key DEMO physics issues, such as plasma vertical stability;
- Detailed studies of the problems of power exhaust in DEMO, with both conventional and advanced divertor designs;
- Safety analysis focusing on upper bounding sequences to outline the confinement strategy, prevention and mitigation systems against the accidents and to assess the worst public dose in the hypothetical accidents.

In the framework of DEMO R&D activities in blanket materials, in 2014 the equipment constructed in ENEA to measure erosion-corrosion of SiC materials in liquid metals (Li-Pb) was delivered to Rokkasho after a successful test in Frascati. It will be used for joint measurements in 2015. A PA to analyse T-contaminated dust from the JET divertor and JET tiles was initiated. The dust and tiles were delivered to Rokkasho, and the preliminary analysis techniques tested. The full characterisation will continue in 2015. In 2014 the activities on DEMO blanket materials performed by KIT concluded. Samples of RAFM steels and joints were sent to Rokkasho for further analysis. A continuation of these activities is under consideration in collaboration with EUROfusion.

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 JT60-SA 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 2014 the implementation of the urgent software development for the remote experiment system (RES) and the experimental data analysis software (EDAS) in JT-60SA has started, with a contract placed by F4E and others in preparation. The EU contribution will concentrate on the development of software for remote participation and data access.

Contracts and Procurement

Procurement Activities

Procurement Activities

The balance distribution of workload between the signature of new contracts and the implementation of those signed during previous years has shifted during 2014, as more and more multi-year contracts are under implementation.

During 2014, a total of 71 operational procurement procedures were launched and 61 procurement contracts were signed to the value of about EUR 391 million. Major operational procurements were awarded and signed in the area of Magnets and Remote Handling but significant procurements were also signed in relation to Buildings, In Vessel and Diagnostics.

In particular, F4E signed the contract for the cold tests of 10 Winding Packs and insertion process on 10 Toroidal Field (TF) coils – this marks the successful completion of Europe's strategy in the domain of the TF coils, part of ITER's impressive magnet system. Through this contract, the TF coils will be tested at extremely low temperatures reaching nearly -200 degrees Celsius/80 Kelvin and will subsequently be inserted within their cases for final assembly in the ITER machine.

A second significant procurement milestone during 2014 was the signature the framework contract for the development and supply of the ITER divertor Remote Handling system. The scope of this multiple framework contract in cascade (3 contracts in total) comprises the design, manufacturing, delivery, on-site integration, commissioning and final acceptance tests of components and systems to be delivered to ITER.

Another noteworthy contract signed in 2014 is related to the manufacturing of the first full-scale prototypes of the Blanket first wall, as this is a technically challenging project which requires until now previously unknown technology. In order to mitigate risks and maintain competition until the series production, F4E has signed contracts with three different entities. Each entity will manufacture a prototype of a Blanket first wall panel, carry out specific industrialisation studies for the fabrication of the series of the 215 panels and present a cost and schedule assessment.

With regards to transversal areas, five framework contracts were signed in the area of Technical Support Services, each of which have been designed to serve several Project Teams of the ITER Department over the coming four years:

- A direct Framework Contract for the provision of irradiation and post irradiation characterisation of materials;

- Four multiple Framework Contracts covering the areas of Nuclear Analysis, Engineering Support Services in the area of electromagnetic and electromechanical analysis of ITER components, metrology, as well as seismic analysis and design of building and mechanical components of the ITER facility.

Furthermore, in order to support the Planning & Monitoring Unit, contracts of a similar nature covering the areas of risk management, cost estimation as well as Dual Use Export Control Services, were signed.

Many of the systems and components belonging to the EU in-kind obligation continue to leave the R&D phase and instead move on to 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 for the ITER and Broader Approach projects and to positively exploit their scientific and technological results. During 2014, a total of eight grant procedures were launched and seven grant agreements were signed. This corresponds to a grant budget of over EUR 14 million.

The most significant grant during 2014 was the framework partnership agreement for the development and design of ITER's Collective Thomson Scattering diagnostic system that was signed with a consortium comprising of Danish and Portuguese European Fusion Laboratories (EFLs). During 2014 a total of seven administrative procurement procedures were launched and 121 procurement contracts (direct, framework and specific) were signed, with a budget of EUR 8.7 million. Within these, two service Framework Contracts for information technologies services supporting the overall F4E activities.

The average time to contract for procurements above EUR 1 million increased significantly during 2014 compared to 2013, mainly due to the larger number of complex competitive dialogues and negotiated procedures. At the same time, the average time to contract for procurements below EUR 1 million and grants decreased significantly, mostly due to the standard nature of the procedures.

Contracts with external experts allow F4E to swiftly answer any technical need that may arise within the different F4E departments and projects. In 2014, 36 expert contracts were signed serving 13 project teams within three departments of F4E.

Intellectual Property Rights

Following the Intellectual Property (IP) policy approved in 2013, a new process has been set up for Intellectual Property (IP) management during procurement procedures and within contracts. It is worth mentioning that the IP database initially maintained by DG Research and Innovation of the European Commission has now been migrated to F4E.

Business Intelligence

During 2014, F4E has continued to develop its pre-procurement activities and tools as well as enrich its interactions with European industry and EFLs in order to enhance the efficiency of its procurement actions.

Through the F4E Industry Portal and the Industry Liaison Officers (ILO) network, F4E has direct contact with European industry.

Other communication industry outreach activities during 2014 include:

- F4E has developed and implemented a pilot project in relation to supply chain and industry mapping that will be further developed during 2015;

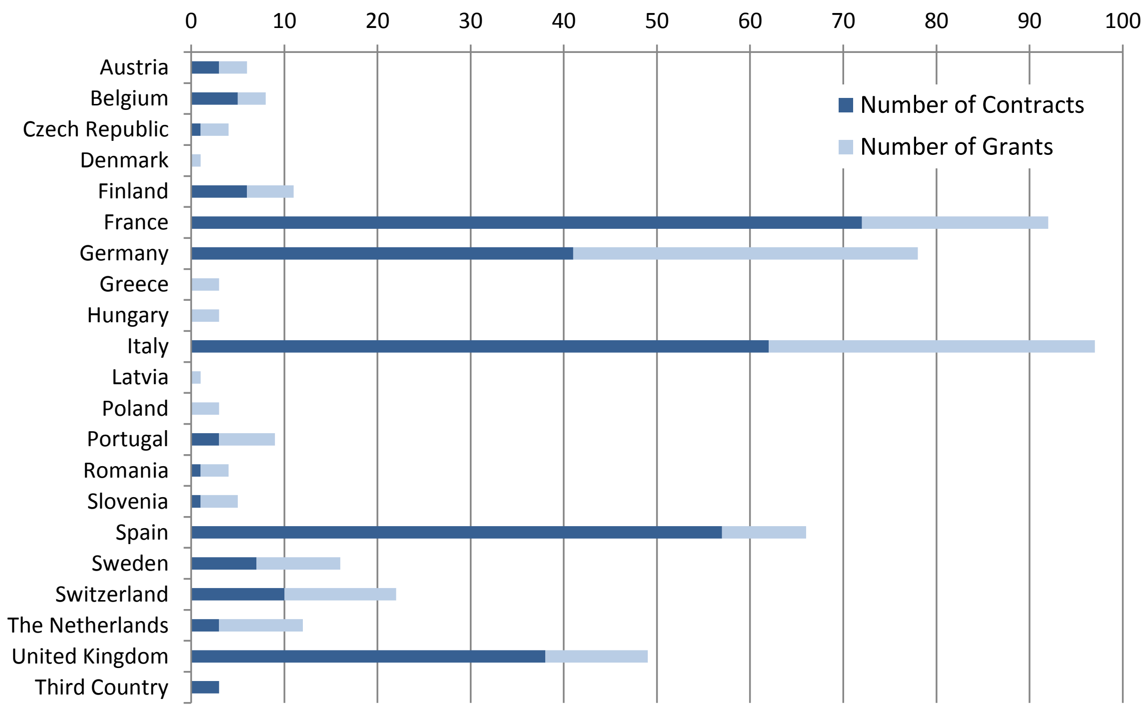
- Four ILO network meetings took place, one of which was held during the SOFT conference of San Sebastian, Spain. These meetings have resulted in a wide dissemination of information on past, on-going and future procurement activities and related needs for the fulfilment of European contribution to ITER;

- F4E organised ten information days in relation to specific procurement actions and three general information meetings for industry. 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;

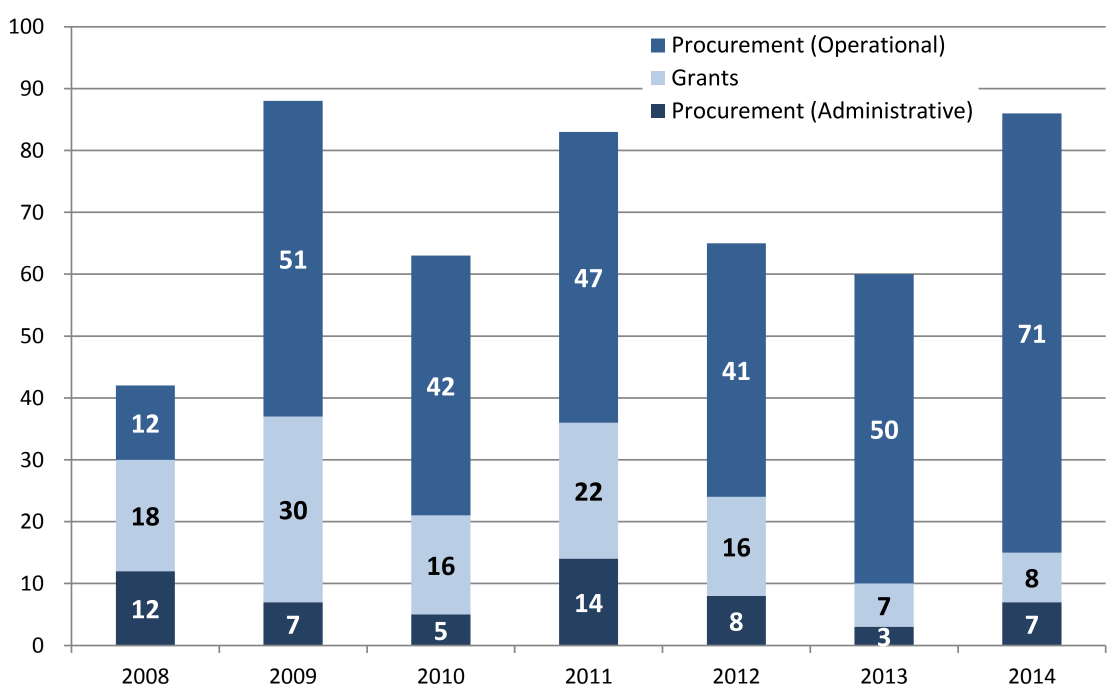
- For more precise identification of capabilities, 18 market surveys have been published through the F4E Industry Portal, involving the participation of almost 200 companies. Most of the market surveys launched in 2014 have been targeted to support the development of procurement strategies;

- F4E Industry & Associations Portal (https://industryportal.f4e.europa.eu) continued to be the main F4E point of contact for companies, and the publication of announcements on the portal have aimed to deliver fresh and frequent information and updates on F4E procurement and pre-procurement activities.

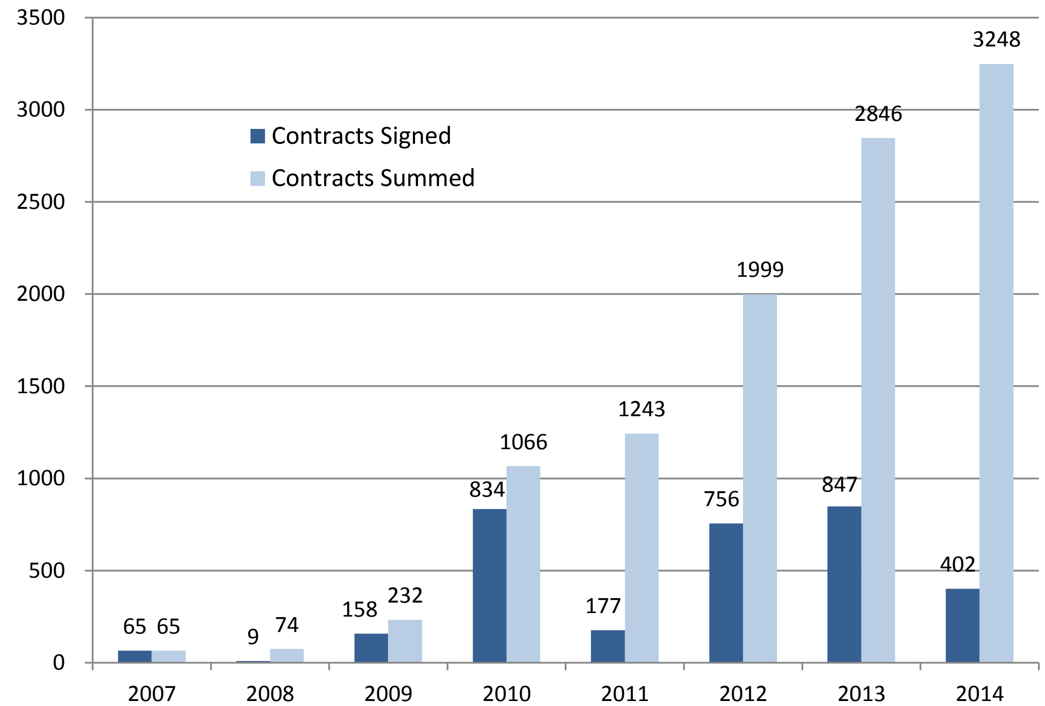
Geographical distribution of awarded contracts and grants (number in the period 2008-2014)



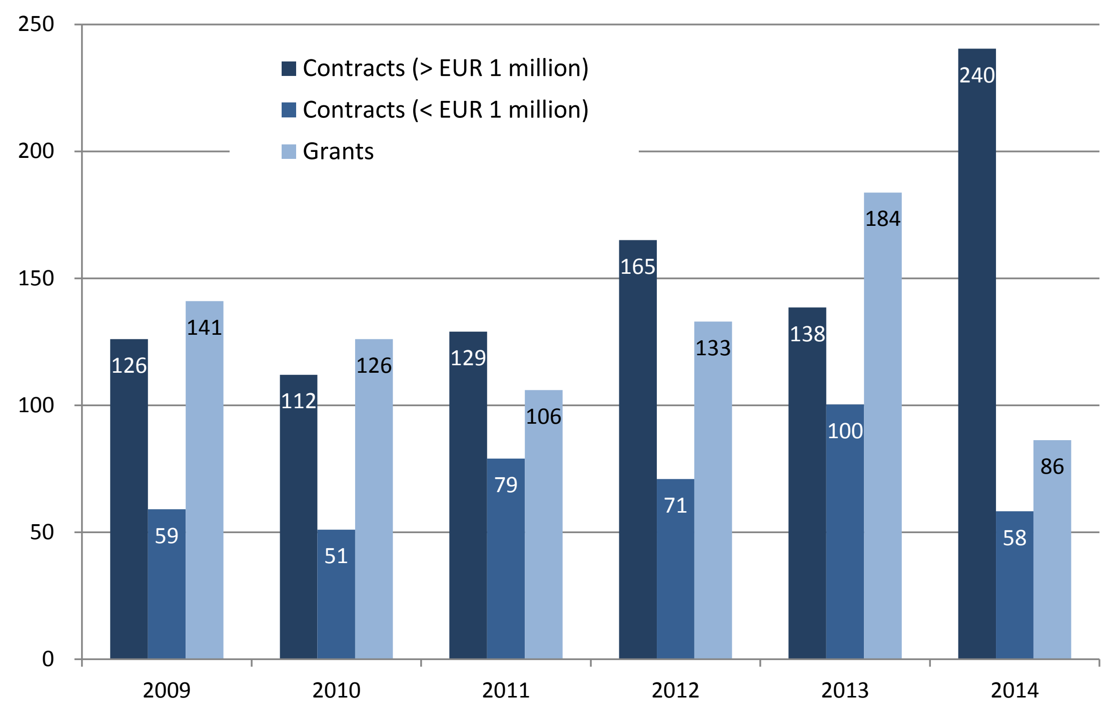
Geographical distribution of awarded contracts and grants (number in the period 2008-2014)



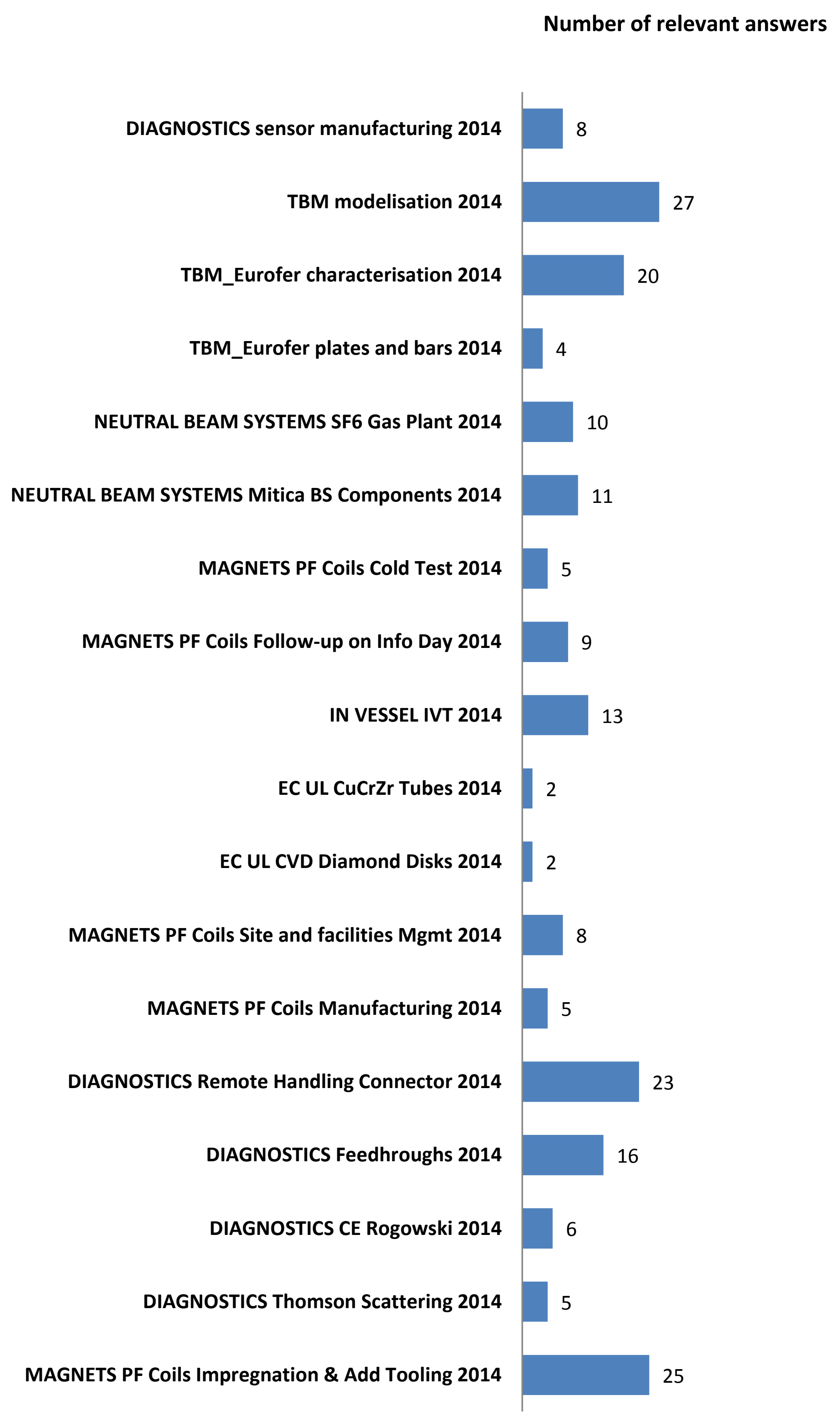
Annual and cumulative value of contracts and grants signed by F4E



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



Market surveys organised by F4E in 2014



Budget, Finance and Accounting

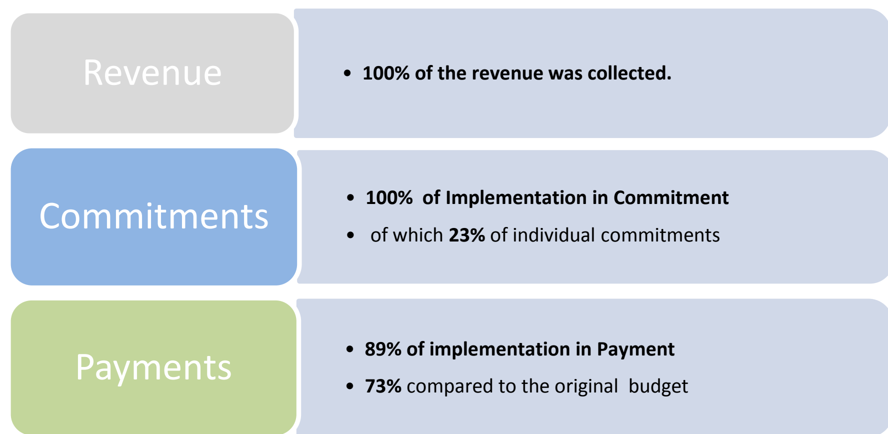
The 2014 financial statements, the budget implementation and reporting on the budgetary and financial management are detailed in the 2014 Annual Accounts which are published separately.

Establishment of the Budget

F4E's budget for 2014 was initially adopted for the global amount of EUR 897.19 million in commitment appropriations and EUR 698.15 million in payment appropriations.

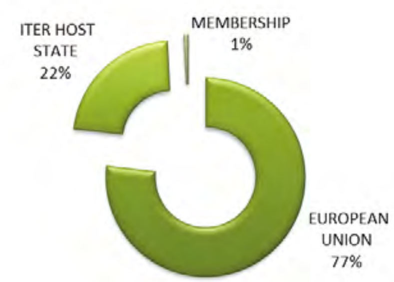
Following budget amendments approved by the Governing Board, the final authorised F4E budget for 2014 was EUR 897.40 million in commitment appropriations and EUR 550.60 million in payment appropriations.

Implementation of the Available 2014 Budget



Revenue

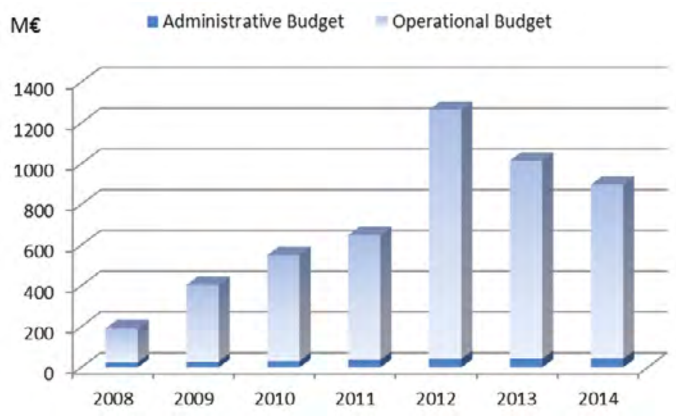
The repartition of revenue for 2014 ensures a fair balance between contributors, and is in line with their relative share for the overall period of ITER construction:



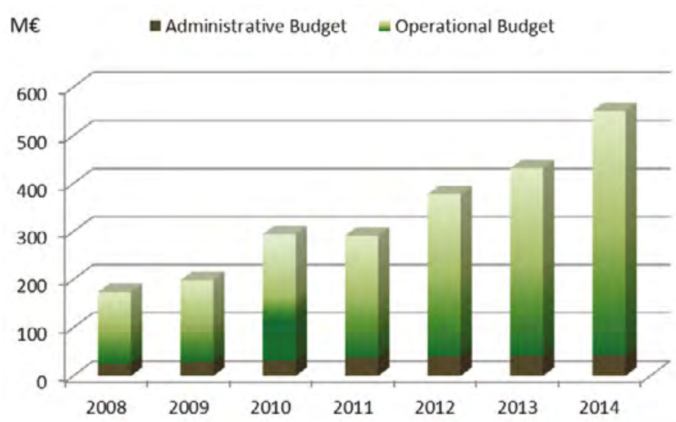
Implementation of the available 2014 Budget

Commitments and Payments

F4E available budgets in Commitment Appropriations (EUR million) since 2008



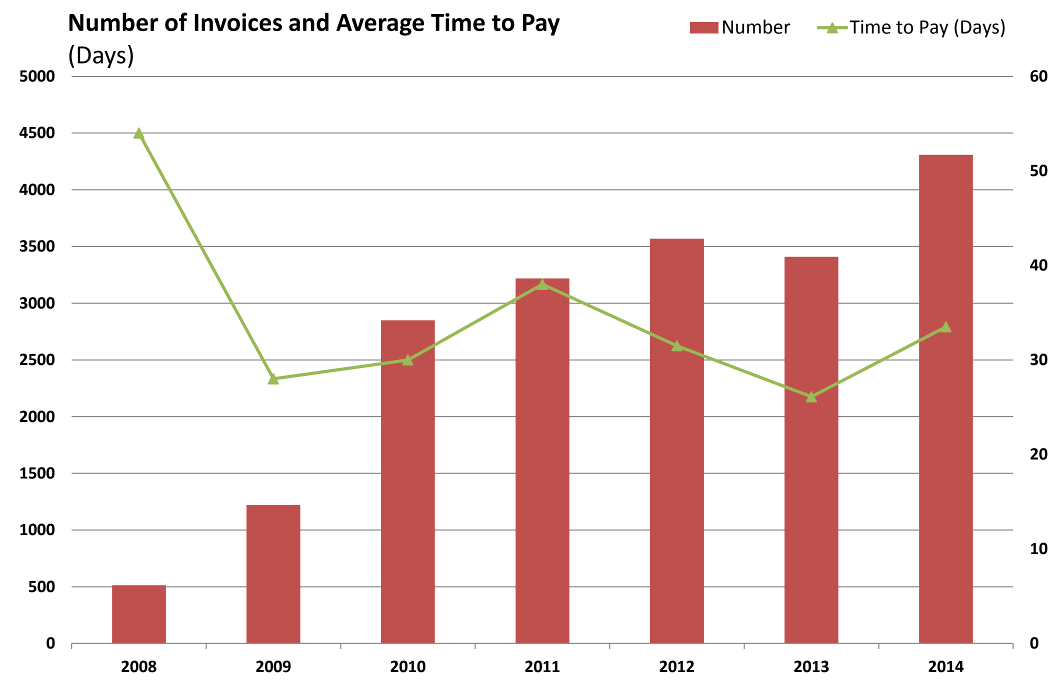
F4E available budgets in payment appropriations (EUR million) since 2008



Implementation of the budgets (%) since 2008

Finance

During 2014 the Finance Unit initiated and verified 4,309 payments, an increase in the number of payments by ~25% in comparison to 2013. Due to this circumstance and to the fact that this Unit has been reduced its Financial Initiation capability by 10% (one staff member less), the average time to pay has increased by ~7.5 days despite the efforts made in streamlining the associated financial processes. An important achievement during 2014 that is hoped to improve efficiency was the implementation of the electronic workflow for payments.



Legal Framework – Accrual Accounting Standards in F4E

According to its statutes, the annual accounts of F4E are fully consolidated with those of the European Union. The 2014 financial statement was established by using the consolidation package provided by the European Commission.

The accounting rules and regulations used in the annual accounts are also laid down by the European Commission. In addition they are on an accrual basis and are compliant with the International Public Sector Accounting Standards (IPSAS).

F4E uses the ABAC system (Accrual Based Accounting) owned by the European Commission and used by many EU bodies.

Staff Missions

The number of missions managed by the mission desk during 2014 was 2,272 meaning an increase of 45% compared to 2013. This increase during 2014 shows the beginning of a trend which is foreseen to continue during the next years, due to the fact that more missions are needed in order to carry out an on-site close control of the implementation of the contracts.

Ex-Post Activities

Ex-post activities include ex-post audits on grants, surveillance and compliance activities.

Ex-post audits on Grants:

During 2014, the Ex-post Control Team launched three ex-post audits on grants awarded to three different beneficiaries from Italy, Great Britain, and Sweden, covering 9 grant agreements for a total amount of 6,134, 419 EUR. These audits were performed by an external audit company (Lubbock Fine Accountants) contracted under the umbrella of the European Commission Framework Contract.

Surveillance and Compliance:

The Ex-post Control Team also performed the first campaign of surveillance regarding three types of financial transactions:

- Signature of the budgetary and legal commitments,
- Advance payments,
- Interim/final payments.

The scope of the campaign was to verify:

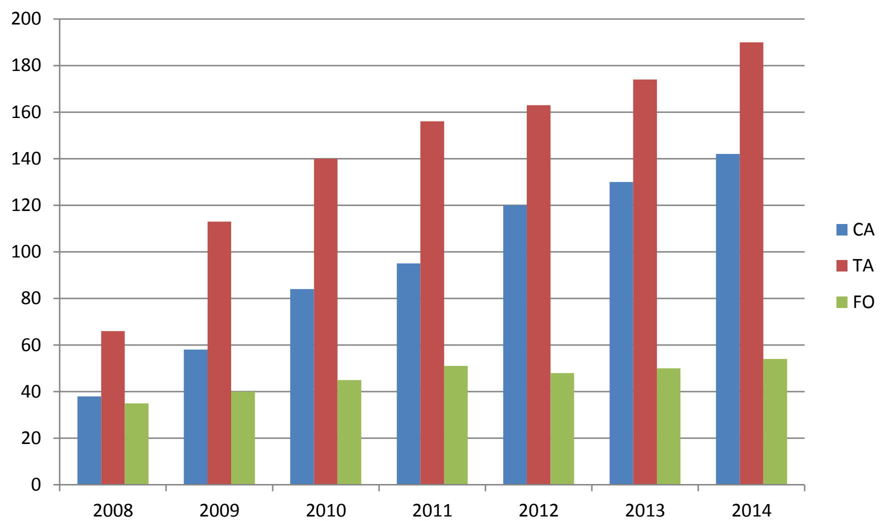
1. The conformity of the processes and the validation of the financial transactions by verifying:
    - the correct implementation of the processes by the services in order, and if necessary, to propose improvements;
    - the correct implementation of F4E rules (FR, IR) and the provisions of the contracts.
2. The appropriateness of the changes done in the organisation in line with the 2013 Corporate Objective to improve F4E's organisational efficiency.

The outcome of the campaign evidenced compliance with the regulation and a gain of efficiency of F4E's financial transactions.

Human Resources

Personnel Selection and Recruitment

As of 31 December 2014, the total number of occupied posts at F4E was 249 Officials and Temporary Agents, and 144 Contract Agents. In addition, as of 31 December 2014, F4E counted on the support of 23 interim staff (22 in Barcelona and 1 in Cadarache) and two Seconded National Experts (SNE). In this context, neither the interim staff nor the SNEs are considered to be F4E staff. The staff in place was respectively 54 Officials, 190 Temporary Agents and 142 Contract Agents.



Evolution of the staff from 2008 to 2014 where FO stands for Officials, TA for Temporary Agents and CA for Contract Agents.

During 2014, 25 vacancy notices were published: four for established EU Officials, 12 for Temporary Agents, eight for Contract Agents and one internal call for expression of interest for SNEs. Overall, 26 selection procedures were completed: 15 from the positions published in 2014 and 11 selections from the positions published at the end of 2013. A total of six Officials, 13 Temporary Agents and 22 Contract Agents took up duties as per the following table (distributed by type of contract, category and department):

Department	FO	TA	CA
Units/Teams reporting to the Director	1 AD, 1 AST	2 AD	2 FGIV
ITER		6 AD, 1 AST	15 FGIV, 1 FGII
Broader Fusion Development			
Administration	2 AD, 2 AST	3 AD, 1 AST	1 FGIV, 2 FGIII, 1 FGII

				2014		
	Dec-13	Dec-14	Variation	Recruitments	Departures	Change of contracts
CA	130	142	12	22	-5	-5
TA	174	190	16	13	-2	5
FO	50	54	4	6	-2	0

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

The average amount of time invested in a selection procedure in 2014 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

Following the entry into force of the amended Staff Regulations on 1 January 2014, F4E conducted a thorough evaluation exercise of the new policy framework adopted by the European Commission. This led to the application of 14 implementing rules covering areas as diverse as working conditions and conditions of employment, ethics and conduct, prevention of harassment, etc. Several other provisions were also submitted to the European Commission for approval but unfortunately the Commission's feedback has not yet been received.

In addition, measures aiming at preventing and monitoring conflicts of interest were also significantly reinforced and adapted to F4E. A significant communication effort was made in order to increase staff members' awareness in this matter.

The Unit also dealt with an increase of its legal activity, in particular in the field of internal appeals.

Studentships schemes

In March 2014, F4E launched its summer studentship scheme for the fifth year running. The scheme aims to provide short-period training (two to three months) to university students as well as to promote awareness, knowledge and understanding of F4E's role in the ITER project and within the European context. In total, 13 studentships were awarded and the students were assigned to the ITER Department (ten), Administration Department (one) and to the Units reporting to the Director (two).

In addition, in September 2014, three European Law graduate students from the Carlos III University of Madrid joined F4E for a period of six months.

Training

The Training Team has established tools to provide a broad training offer appropriate to F4E's staff learning and development needs. Some of the actions proposed are the Learning and Development Framework and the "Coming up" section on F4ENet, where training activities and information sessions were published in the form of a calendar including the information on how to apply. This initiative allows staff to select and organise their trainings in advance.

During 2014, there has been a focus on the recommended trainings for specifics tasks, targeting job development and improvement of the four learning paths.

Also, for the first time, an exercise was launched to gather all the training needs for the following year. This request of information was sent to all Heads of Unit and Project Team Managers of F4E at the end of November and was actively supported by the Unit and Department Assistants. This information contributed in designing a training plan for 2015 which is more targeted to the real needs of staff, including technical trainings that were not included in the overall plan until now.

The following table contains figures related to training activities in 2013-14, as well as the comparison with the previous year:

Type/number of trainings:	2013	2014
At the European Commission (SLA)	68	71
Collective training organised at F4E	59	70
External training courses + conferences and seminars	98 + 143	165
Staff attending language courses at F4E	221	170
Average number of training days per staff member	4.9	6.7

Career Development

In May 2014 a career development strategy was presented to the Senior Management of F4E. This was subsequently approved and various actions commenced in 2014 in relation to this strategy, such as the creation of a specific working group for this topic and the development of a project to implement a skills database. The main goals of this strategy are to enable F4E to put in place the right people in order to best achieve F4E's objectives, map F4E's needs for the future, enable the creation of career opportunities for staff members, build a high performance workforce and support the appraisal process. The 2014 promotion/reclassification exercise was the second exercise under the revised system in place since 2013.

Working Conditions/Social Policy

Some of the main achievements in 2014 related to this sector include:

- 2014 F4E Policy on Gifts: this Decision substitutes the one taken in 2009, simplifying the process in respect of low value gifts and favours;

- Implementation of the Reform of the Staff Regulations and the Conditions of Employment of Other Servants of the EU: update of our leave management application and of all the processes and forms linked to our sector, together with the update of related contents on our intranet, F4ENet. In order to inform staff, several internal communication actions were also implemented;

- In view of the termination of the current contracts in place for the Medical Service and with the aim of improving the quality of the service, the necessary work for the launching of the Call for tender was started;

- Leave management application: a lot of testing work was done together with the ICT Unit for improving the current application LeaMa1. LeaMa2 was launched at the end of 2014;

- International schools: 136 children are enrolled in 19 international schools, covering different EU languages, for the academic year 2014-2015;

- Relocation: 19 newcomers were provided with support for relocation services.

During 2014, 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.

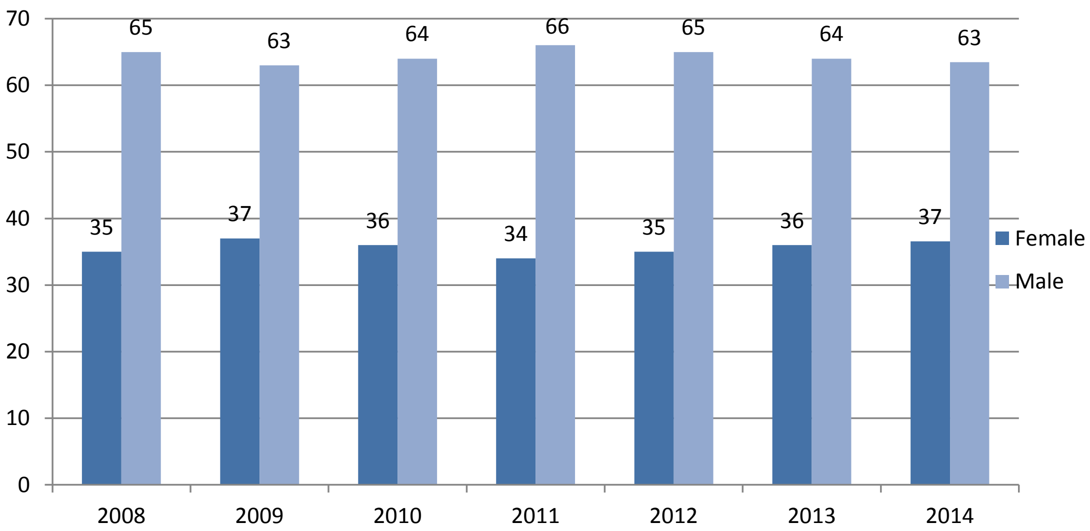
As in previous years, health campaigns targeting all staff members were developed based on the results obtained through the annual check-ups undertaken. Thus, health campaigns were tailor-made and always in the interest of staff. In the Flu Vaccine campaign, 31 staff members were vaccinated at the F4E 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.

As for the Complementary Healthcare insurance currently in place at F4E, an agreement was reached with PMO and the healthcare provider regarding birth services. Starting from the month of October, birth services were available to staff members for a fixed price under the ceiling established for Spain, and with PMO providing advanced payment for the entire sum.

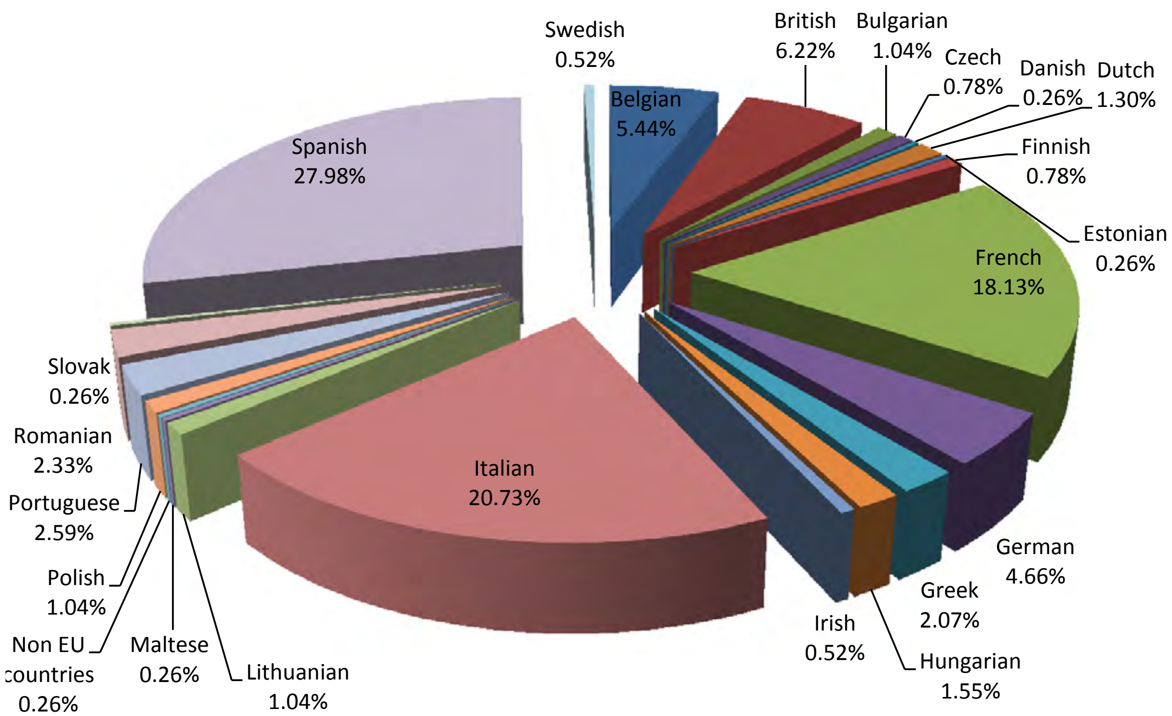
Staffing Statistics

In the following graphs statistics on the gender and nationality of F4E staff are provided.

Gender distribution for all staff (%)



Breakdown of staff by nationality (%)



Legal and Control Environment

Internal Audit

In 2014, F4E's Internal Audit Capability (IAC) delivered the report on the Review of Monitoring of Contracts Implementation in the area of ITER Buildings, the follow-up audit report on the Management of Experts Contracts as well as the recurrent report on the access rights to F4E's accounting and related systems (ABAC). The Internal Audit Service of the European Commission (IAS) provided the report on the Limited Review of Contracts Management – Entity-wide Controls and the follow-up audit report on Preparation of Procurement Arrangements. These internal audit engagements resulted in 26 new recommendations aiming to further improve F4E's governance, risk management and internal controls.

In addition to the assurance work, the IAC also assisted F4E's management by providing consulting and advice, in particular in the areas of budgeting and efficiency of document review and the release of hold points in relation to implementation of one of F4E's major contracts.

Overall Control and Monitoring Strategy

The "Overall control and monitoring strategy" which was adopted in 2012 sets out the framework to ensure that operational and financial transactions are implemented to the highest standards expected for such a project as ITER. The strategy contributes to the "assurance chain" which provides reasonable assurance to the F4E Director and external stakeholders on the state of internal control in F4E and is composed of the following elements:

- Integrated Management System;
- Control Environment;
- Organisational Improvement Plan.

Integrated Management System (IMS)

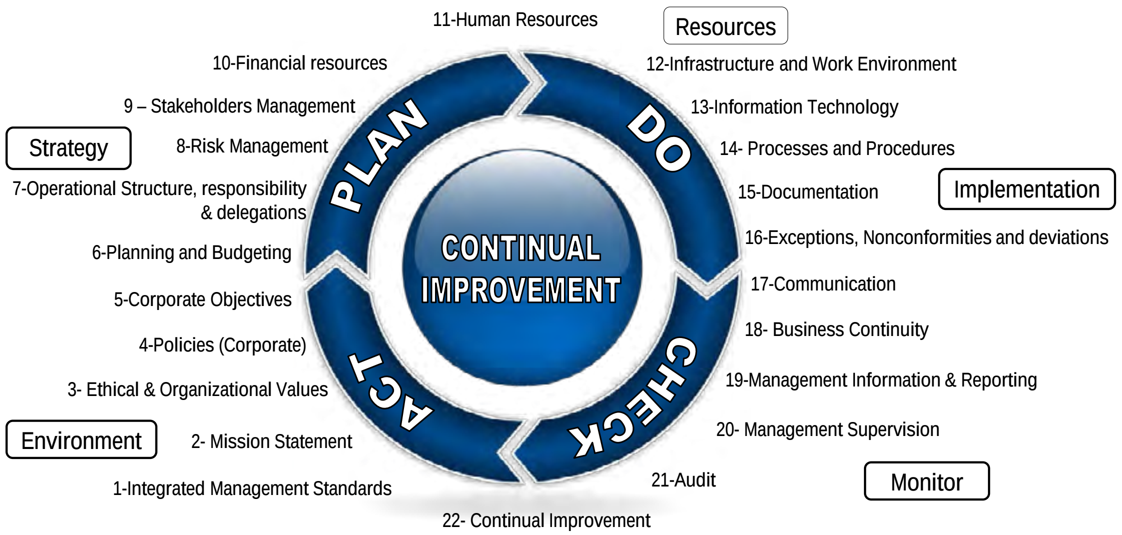
The F4E's Integrated Management System (IMS) combines the two control environments within which F4E operates:

- the ITER-wide Quality System which is intended to ensure the performance of ITER and the compliance with the nuclear safety requirements;
- the COSO-based Internal Control Standards to manage the organisation.

The Integrated Management System Standards (IMSS) are the backbone of this system. A set of standards specifically developed by F4E, integrating the ISO-9001 quality requirements, the European Commission Internal Control Standards and the ITER project quality and safety requirements. In 2013, the IMSS were reviewed and streamlined, reducing the number of standards from the 26 standards initially adopted in 2012 to 22 standards which cover the previously existing requirements in a more efficient and simplified manner.

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).

Finally, in its 3rd 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".



Control Environment

The control environment was further enhanced in 2013 by including a new corporate supervisory function. It continued to be implemented in 2014 and adapted to respond to audit recommendations and the evolving needs of the organisation. The F4E control environment is composed of the following assurance functions:

- External audit (European Court of Auditors);
- Internal audit (IAS and IAC);
- External Assessment;
- Ex-Post Controls on Grants;
- Corporate Supervision Function (including Financial and procedural controls);
- Corporate Risk Management;
- Quality Management System.

In addition to these assurance functions, each staff member who has received a (sub)delegation for the implementation of F4E's 2014 budget is requested to provide their personal 'Declaration of Assurance' for the budgetary area for which they were responsible. In 2014, 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, 36 declarations were received for 2014. These declarations, together with the reports from the assurance functions form a basis for the F4E's Director's Declaration of Assurance, and are based on the different elements (Sound Financial Management and Ex-Post Controls, Conflict of Interest, Deviations and Exceptions registered, Risk Management, Internal Audit Reports and Assessments and Court of Auditors' Observations).

During 2014 F4E improved how the different assurance functions interact together in a constructive and efficient manner. In particular, the central database – RAPID – which is organised around the IMSS and centralises all the main findings, observations and recommendations was improved and became available for use online in 2014. The integrated management system is audited annually and assessed by external and internal assurance providers, and their recommendations are used to improve the system and feed the annual improvement plan.

External Audit (European Court of Auditors)

In November 2014 the European Court of Auditors (ECA) adopted the final report on the 2013 annual accounts of F4E where it expressed an unqualified opinion, meaning that in the Court's opinion:

- F4E's annual accounts present fairly, in all material respects, its financial position as at 31 December 2013 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 31 December 2013 are, in all material respects, legal and regular.

The Annual Report included, in the Statement of Assurance section, a new sub-section 'Emphasis of Matter' raising awareness on the risks faced by F4E in relation to the cost and schedule of the overall project. As a consequence, the Budgetary Authority invited the F4E Director to the hearings both at the Council of European Union and at the European Parliament in order to explain the measures taken to address those risks in the context of the discharge procedure 2013.

It should be stressed that in 2014, F4E continued its effort to reinforce its internal control system, in particular the monitoring of the cost deviations at contract level, as this has been a concern of the auditors during the last years. This issue has the full attention of the governance and senior management at F4E, which is ensuring that adequate measures are taken to address it.

Furthermore, the Annual Report also listed a number of observations which did not affect the assurance. By the end of 2014, the status of these observations was the following:

Area	Implemented	In Progress	No Action	Total
Presentation of the accounts		1		1
Implementation of the budget			1	1
Internal Control Systems		1		1
Operational procurement and grants		1	1	2
Overall control and monitoring of operational contracts and grants		1	1	2
Late payment of membership contributions			1	1
Legal Framework		1		1
Intellectual property rights and industrial policy	1		2	3
Conflict of interest		1		1
Annual Activity Report			2	2
Host State Agreement			1	1
Rules implementing Staff Regulations		1		1
Total	**1**	**7**	**9**	**17**

Internal Audit (IAS and IAC)

In 2014, F4E's Internal Audit Capability (IAC) delivered the report on the Review of Monitoring of Contracts Implementation in the area of ITER Buildings, the follow-up audit report on the Management of Experts Contracts as well as the recurrent report on the access rights to F4E's accounting and related systems (ABAC). In addition to the assurance work, the IAC also assisted F4E's management by providing consulting and advice, in particular in the areas of budgeting and efficiency of document review and the release of hold points in relation to implementation of one of F4E's major contracts.

The Internal Audit Service of the European Commission (IAS) provided the report on the Limited Review of Contracts Management – Entity-wide Controls and the follow-up audit report on Preparation of Procurement Arrangements.

These internal audit engagements resulted in 26 new recommendations aiming to further improve the governance, risk management and internal controls at F4E and which were all of them accepted by the Management.

External Assessment

As requested by the Council of the European Union in its conclusions of 12 July 2010, a 3rd Annual External Management Assessment was completed in 2014, covering the period 1 August 2013 to 31 July 2014. The main findings of the report had been already identified by F4E or the external or internal auditors. F4E is currently addressing these findings in its improvement plan 2015 and reports on its progress to the Governing Board.

Ex-post Controls on Grants

A Multi-Annual Ex-Post Control Strategy on grants and procurement contracts was initially adopted in 2012 and revised in 2014. For grant agreements, audits are outsourced via a Framework Contract concluded between the research DGs and Agencies of the European Commission and three external audit firms. At the end of 2013 three audits at grant beneficiaries were launched, for which F4E has received two final reports and one preliminary audit report.

For procurement contracts, the audits are performed by the internal audit capability (IAC) of F4E and cover the financial, compliance, quality and performance aspects of contracts resulting from procurement procedures. In 2014 the IAC delivered the Review of Monitoring of Contracts Implementation in the area of ITER Buildings.

Corporate Supervision Function

The Supervision Function was established in 2013 and is composed of the Financial Supervision Function and the Internal Review Panel. As regards the Financial supervision function, a first campaign was launched in 2014 in order to analyse efficiency and compliance aspects of the financial transactions.

In 2013, F4E improved and streamlined the financial decision-making process by delegating and sub-delegating this empowerment from the Director to Department and Project Team level. As a consequence of these changes, a significant efficiency gain was observed both in terms of reduction of compliance issues and reduction of the time required to complete the different processes. The efficiency gains range 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 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 1 million and less than EUR 10 million and grants or framework partnership agreements with a maximum F4E contribution equal to or above EUR 400,000 and less than EUR 4 million. In 2014 the Internal Review Panel met 17 times and reviewed 17 contracts and two grants. In addition, the IRP issued general recommendations to the Senior Management Meeting on how to address recurring issues. This panel complements the Executive Committee, the body which provides the Director with recommendations on the strategies in relation to procurement, grant activities and the award and follow-up of contracts above EUR 10 million.

Corporate Risk Management

During 2014 the methodology to monitor corporate risks was further developed and the risk log was updated, in accordance with the 2014 Corporate Objectives. The risk log was also linked to the IMSS, allowing a categorisation of risks by standard impacted.

Quality Management System

In 2014, F4E continued the implementation and development of the Quality Management System through five main activity areas:

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

The development and establishment of a Quality System in F4E:

- is part of its overall management strategy;
- is included in obligations such as the ITER project items provider (ITER IO and French authority regulations requirements);
- assists the internal management in the Internal Control Standards compliance.

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. In 2014, F4E has reached the following situation:

(iv) Definition of the overall F4E processes (F4E process map);

(v) Details of the macro process to provide the information on the core activities of F4E;

(vi) The list of processes needed for achieving the intended F4E outputs;

(vii) Areas to further document or to further improve in each macro process.

In 2014, the statistics of the process development were:

Processes Status (out of 168)	Total	Approved			In Development			Software tool-based
		Process	Procedure/ Policy	Updating	Review	Mapped	Preparation	
31 Dec 2014	170	121	9	5	14	4	19	3

For each process all the actions, documentation, appropriate review and approval, reporting and records are defined.

Continual Improvement of the Quality Management System in 2014

The continual improvement work is an on-going process in accordance with IMSS 22 which 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, preventive and improvement actions and management review.

F4E implemented the following improvements in 2014:

(i) Revision of the F4E Sign-Off Authority Policies: Project, Deviation and Nonconformity, Administrative and Committees Documents;

(ii) Update and Issue of the overall Supplier Quality Requirements (ITER, 2014 version);

(iii) Improvement of the Working Procedures Workflow and ownership;

(iv) Improvement of the readability and usability of the Sign-Off Authority policies, in line with the logic of IDM;

(v) Update of all the operational and core administrative processes to include the sign-off authority;

(vi) Operational Quality Guidance 2014 training sessions to all operational officers

(vii) Further development of the F4E process map, including the subsidiary macro processes.

In relation to organisational efficiency, particular attention was paid during the past two years on the development of support processes (Procurement and Finance) to improve their efficiency. The results of the first Financial Supervision Campaign were positive.

An Improvement Network was established in 2014. It aims to facilitate the smooth implementation of working procedures and to provide an opportunity for members to share ideas, suggestions or concerns. In 2014, ten meetings took place. As it has proved to be a successful instrument, its mandate will be enhanced in 2015.

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 our suppliers are being monitored and that quality is being adequately implemented:

- Each audit result is recorded in an audit report, which includes the identification of strong areas, improvement areas and nonconformities;

- Where improvements or nonconformities are identified the report is followed by an action plan from the auditee;

- In 2014, out of the 19 quality audits planned:

Audits	Cases	%
Operational contracts performed and reported	14	73.7%
Grant agreements performed and reported	2	10.5%
Internal on quality implementation performed and reported	1	5.3%
Postponed (due to contractual progress)	2	10.5%
Total	19	-

- Two operational contract audits were postponed to 2015 (and will be performed under the 2015 plan) due to the progress of the contracts to be audited not being mature enough;

- At the end of the year the Annual Quality Plan for 2015 was developed and approved for implementation;

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

Audit Result	Cases	%
with an Acceptable Result	16	94%
with an non-Acceptable Result	1	6%

Audit Finding	Cases	%
Strong Areas	21	12.3%
Improvement Areas	129	75.4%
Nonconformities	21	12.3%
Total	171	-

Quality Assurance in the Operational Projects

One of the major Quality Assurance (QA) activities is the support to the operational projects to ensure the correct implementation of the quality programme. These activities 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 Organization-Domestic Agency coordination meetings in quality and safety and issue of the implementation templates;

- Guidance training on QA to all the operational officers;

- Full support to the technical departments on quality issues of Contracts and Grants, verification of the calls 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;

- Supplier quality audits and full support on QA to the kick-off, progress meetings and control point quality related visits.

Deviations and Nonconformities in 2014

In 2014, the main types of Nonconformities and Deviations are represented below:

Nonconformities (F4E Classification)	Cases	%
Major (impact on customer critical requirements)	109	22%
Minor (impact on customer non-critical requirements)	224	45%
Relevant (impact on F4E contract, but not on customer requirements)	159	32%
Technical Exception (no impact on F4E contract or customer requirements)	3	1%
Total	496	-

Deviations (F4E Classification)	Cases	%
Level A (no impact on F4E contract or customer requirements)	10	2%
Level B (impact on F4E contract, but not on customer requirements)	223	41%
Level C (impact on customer requirements)	176	32%
Cancelled or still to be defined (in the process of assessment)	136	25%
Total	545	-

Deviations (by type)	Cases	%
F4E DR (deviation request by F4E, internally or to ITER IO)	60	11%
Supplier DR (deviation request by the supplier to F4E)	248	46%
Deviation Notice/Order (deviation by F4E towards the supplier)	237	43%
ITER IO DR (deviation request by ITER IO towards F4E)	0	0%
Total	545	-

Deviations (by initiator)	Cases	%
Initiated by F4E (F4E-DR and DNO not triggered by ITER IO)	284	52%
Initiated by supplier	248	46%
Initiated by ITER IO (F4E-DR and DNO triggered by ITER IO + ITER IO-DR)	13	2%
Total	545	-

Organisational Improvement Plan

F4E performed an assessment of its integrated management system in 2014, analysing all the risks, weaknesses, observations, recommendations and actions identified by the various audits and assurance functions. This analysis, structured around the IMSS, resulted in the following conclusions:

- IMSS 14 'Processes and Procedures' is the most impacted standard with around 30 audit recommendations related to it and IMSS 15 'Documentation', which in large measure is related to IMSS 14 on 'Processes and procedures', has been impacted by eight audit recommendations. The main cause is the significant number of recommendations in the areas of procurement, human resources and procurement arrangements, and which concern the development and improvement of the related processes and documentation. This reflects the need of rationalisation that F4E has to pursue in the development of its working procedures and processes and the formalisation of the Process Map.

- IMSS 6 'Planning and Budgeting' and IMSS 19 'Management Information and Reporting' are the third and the fourth most impacted standards. This is mostly due to the recommendations related to the development at the contract level of the Cost Baseline (CB), the Cost Estimate at Completion (CEAC), Earned Value Management (EVM) and the deployment of the Resource Loaded Schedule (RLS). All these actions are currently being pursued, although they are highly dependent on the schedule of the project, which is currently being revised.

This assessment reveals the need for F4E to tackle the growing number of audit recommendations with a harmonised and integrated approach to address both compliance and efficiency requirements. Consequently, the following areas of improvement have been identified as a priority for the organisation in 2015:

- "Project control and contract management" which are critical to the organisation. A number of actions are already in progress in this area, but some other actions will need to be taken to adequately mitigate the associated risks and to ensure that there is a coordinated, harmonised and efficient approach in further developing the related activities, processes and procedures.

- "Rationalisation of working procedures" aiming at further simplifying processes to gain efficiency. Improvements are especially needed in the area of procurement activities, because of the high number of audit recommendations still to be implemented and which should be tackled in a rationalised manner.

Information and Communication Technology

During 2014 the main achievements in the area of Information and Communication Technology (ICT) were the following:

- The launch of the **F4E Procurement Platform** provided a workspace to coherently manage the key data related to the procurement process up to contract signature. In addition the system links into schedule, financial and contract data to give a complete overview of the procurement status while also providing time saving procurement document generation features.

- The **Recommendations & Action Plan Information Database (RAPID)** was rolled out to facilitate a more efficient follow-up of both internal and external audits, reviews and risk assessments. Recommendation and action owners are now fully enabled to give updates at any time while management reporting features give a clear overview on the progress of F4E's audit response activities.

- **eSignataire** was deployed for all F4E to process all invoice payments without paper. The roll-out was gradual and the ICT Unit worked closely with the services to create a solution that delivers added value to the end-users in terms of traceability and time-saving, as well as complying with the financial regulation.

- The **Contract Management Platform** has gone through two major development iterations. The platform increased its functional scope and delivered additional features in terms of deliverable management. Functionalities linked to the usage of document versions were developed and tested.

- A new **Framework Contract for Datacentre Services** was signed in July. These services span from housing to managed services. Disaster recovery provisions make use of this new contract as well.

- Several **security awareness training** sessions were held in July for all staff.

- Since November 2014 the European Maritime Safety Agency is hosting a part of the F4E IT backup infrastructure. Data replication to EMSA increases our disaster recovery possibilities and started in November.

- The **F4E EDB/PLM Smarteam solution** was finally (Q2/2014) rolled-out in production. At the end of 2014, there were already 52 staff members using the product: 10 intensive users (from the CAD Office and the Metrology Group), 38 workflow/viewer users (Technical Reporting Officers from ITER Department Project teams), and 4 users from analysis and codes.

- In the area of **ICT governance** progress was made in the definition and adoption of policies and processes. Within the ISO 20000 framework the following actions and activities were carried out:

  - o Development of capacity management and availability and capacity management processes;
  - o Development of first (two services) capacity and availability plans;
  - o Enforcement and use of change and release management processes, supported by a reviewed workflow in the ITSM tool;
  - o Agreement and signature of Service Level Agreements (SLA) with main customers of the ICT Unit;
  - o Deployment of a Proof of Concept for the monitoring of Service Levels. The tool was deployed in preproduction environment and it will be rolled-out in production during the first half of 2015.

- A **business impact analysis** exercise for all of F4E was started under the guidance and coordination of the ICT Unit. Results are expected by the end of Q1 2015.

- A pilot (Proof of Concept) for the v**irtualisation of 3D software (3D-VDI)** was initiated. The goal was to assess the most important existing VDI technology in the market to explore the possibility of virtualising CATIA workstations and Analysis and Codes workstations, focusing on performance and availability, with the goal of making them available not only internally but also remotely from the internet. The final conclusions will strongly depend on the feedback received from the test users at the end of the test phase (Q1/2015).

- A policy for the delivery, management, support and use of **Sharepoint sites for internal collaboration** was drafted. Several Sharepoint sites have been delivered during 2014. The ICT Unit has provided training, support and related material (including training videos).

- Implementation of a **new backup tool for laptops** allowing laptop users to automatically backup and/or synchronise local stored data with a central data repository, and be able to create local and remote backups.

- Network connectivity between the Garching antenna and Barcelona headquarters was redesigned and implemented allowing maximum ease of access from Garching to all F4E IT applications and services.

- **ICT Service Desk**: On-going support for all F4E users has been regularly provided with a high degree of customer satisfaction. During 2014, 4,817 requests (2,543 incidents, 2,274 service requests) were received and as many were resolved. The overall backlog at the end of the year was 25 open requests (17 incidents, 8 service requests).

Corporate Services

Offices and Other Support Services

In 2014, 36 new staff members arrived and there were 62 internal office moves as well as 5,600 internal and external meetings. Controlled access to F4E's offices was provided for more than 4,100 visitors. Throughout the year, appropriate solutions were devised in order to cope with the limited space of the building. A new F4E assets policy (physical inventory of all F4E administrative assets) was introduced.

Awareness of staff on security and safety issues was raised in 2014 by the organisation of the first security and safety information campaign, as well as arranging the trainings in first aid and fire emergencies.

Several social actions were conducted in order to strengthen F4E's anchoring into the local social network, including the campaigns for blood donation by F4E staff, the food campaign for the Fundació Banc dels Aliments and a Christmas toy collection for underprivileged children living in Barcelona.

Communication and Stakeholder Relations

With regards to information and communication, one of this year's main achievements has been to highlight Europe's contribution to ITER through a series of success stories stemming from the construction site and the manufacturing facilities around Europe. In close collaboration with the F4E contractors and stakeholders, we have identified some key milestones, capitalised on resources, coordinated our key messages and targeted generalist and specialist print publications, as well as online and social media.

The completion of the Tokamak slab together with the signature of some key contracts in the areas of Magnets, Cryogenics, Remote Handling and Diagnostics have allowed us to develop a variety of media stories illustrating tangible R&D, financial and commercial benefits. Europe's competitiveness and entrepreneurship have been amongst the narratives used by the media echoing an overall positive message regarding ITER. F4E's contribution to the ITER IO media trip, by bringing one-third of the 40 journalists invited from all over the world, has given Europe the possibility to speak directly to opinion makers and to showcase the achievements of some contractors to different media outlets. In terms of media coverage, F4E's presence has increased slightly compared to last year with reports from 368 media sources. F4E's YouTube channel viewings have doubled since last year exceeding 150,300 viewings thanks to 10 new clips using a personal narrative, creativity and good quality photography. The number of followers of F4E's Twitter account has also doubled to over 2,000 allowing F4E to spread its message further to fusion laboratories, science reporters and fusion enthusiasts.

Interviews with industry, SMEs and fusion laboratories through short films to illustrate their involvement to the ITER project has been another important element of the work that has been conducted this year. The production and release of the clips in collaboration with suppliers has worked well and has helped us to raise awareness internally and within the broader fusion/energy communities regarding our collective achievements. Sharing these clips and posting them on the different media and social platforms has triggered off more interest for the project and has allowed F4E to make a stronger case to policy-makers about the importance of investing in ITER. In parallel, we have produced a short animated clip to explain in simple terms how to submit an F4E tender, so as to help potential bidders understand how public procurement works and to encourage them to apply.

F4E has participated in a number of policy and scientific events in order to promote different aspects of its work. The German and Danish Industry Days have brought together new companies and R&D centres with a clear interest in the ITER project. The political tone of the Italian Presidency event has helped policy-makers and business representatives to tackle strategic questions such as Europe's investment in energy R&D and the added value of fusion energy. Scientific events such as the IAEA and SOFT conferences gave F4E the opportunity to further relate to its stakeholders and in the case of the latter event, plan a series of sessions to inform attendees on the future calls.

In terms of stakeholder relations, 2014 saw the consolidation of the different forums which had been established to ensure a continuous interaction with the F4E main stakeholders, in particular the European Fusion Laboratories, industry and EU Member States. The finalisation and implementation of an Action Plan to establish a partnership between F4E and the European Fusion Laboratories has been recognised as an important development in managing the relations with this important stakeholder group. The continuous interaction with industrial representatives, both in structured institutional meetings, such as 'the Industrial Liaison Officers' and the 'Fusion Industry Innovation Forum meetings', or bilateral dialogues with companies, has provided invaluable input in the review and development of the way that F4E does business with industry.

F4E continued its collaboration with the network of Industry Liaison Officers (ILOs) in its communication activities through systematic updates regarding communication actions, the frequent distribution of material (clips, images and press releases) in order to capitalise on their networks and has offered support to information day events hosted in different countries. In the spirit of good collaboration and efficiency, F4E, the European Commission and ITER IO, have agreed on a set of priorities in the fields of audiovisual production and annual objectives. F4E has participated to the ITER IO Communication and the EFDA Public Information Network meetings in order to share information and establish joint activities. Last but not least, F4E, in collaboration with four other Agencies of the EU, has coordinated a workshop sharing good practice and exchange of know-how in the field of communication.

With respect to publications, F4E has continued with the online and print version of its flagship publication, "F4E News", covering a broad number of themes. The "F4E Annual Report" has been condensed and enriched with new key statistics. A new publication, "F4E Highlights", has been launched illustrating the key annual achievements in an extremely visual manner. In the field of internal communications, F4E Talks have continued their success, and has given the opportunity to members of staff and external speakers to present their work and raise awareness about key ITER technologies.

F4E and CNIM representatives welcome a group of international journalists at CNIM (Toulon), where the ITER TF coil radial plates are being manufactured

F4E interviews Stefano Pittaluga, ASG Project Manager, for the production of ITER TF coil winding packs

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

ITER Industrial Info Day opening ceremony. From left to right:Prof. J.Sánchez, Prof. H.Bindslev, E.Hernáez, JP. Uriguen, ML.Castaño, Prof.O.Motojima

Staff Committee

During 2014, the Staff Committee (SC) addressed the majority of its work programme goals while dealing with several other events in cooperation with the F4E Departments involved.

- In April 2014, the Human Resources Department asked for SC consultation on the list of the Implementing Rules to be adopted by the European Commission in the framework of the 2014 reform, including a calendar and deadlines to submit draft/ request for changes. The consultation – which concerned rules on working hours and teleworking, Contract Agent appraisal and reclassification, and Implementing Rules applying by analogy – ended in October 2014.

- In May 2014, following a number of queries and concerns expressed by staff members as well as previous exchanges with the Administration Department, the SC performed an analysis of the F4E selections organised during the recent period and sent a note to the Director with main findings and suggestions for improvement (publication procedure, internal awareness selection criteria, external selections as an alternative to internal promotion and career development, transparency and conflict of interest).

- Following the feedback from the F4E staff engagement survey which was launched in March 2014 and presented in June 2014, F4E's Director expressed his concerns and launched a short-term action plan. Dialogue with the Staff Committee was one of the actions identified. The SC decided to gather input from the staff and launched a direct consultation and created a dedicated Working Group (WG). The WG – which was composed of 4 SC members and 7 staff members – put in place a specific mailbox as well as a ballot box for anonymous input, met more than 170 staff members and presented a list of preliminary findings to F4E Management during the Management Meeting on 3 July 2014. A table gathering all input received from staff; including suggestions for improvement to the Task Force was presented to F4E Management on 16 July 2014.

- 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.

- The 2014 SC budget of EUR 75,000 has been employed to address staff-related concerns (such as welfare, support to children, social activities and clubs). Every year staff requests for support from the SC and interest in the activities of the SC increase (as confirmed in the various surveys and the large show of attendance at SC events).It should however be noted that almost all SC activities are co-financed by the F4E staff members. Although the number of staff members continues to increase, the Staff Committee is constantly decreasing the number of activities taking place and the amount of money in co-financing in order to align with F4E budgetary constraints.

- The SC has been very active in organising activities and events related to sports, culture, solidarity, and team-building – all aimed to foster wellbeing within F4E.

- The number of F4E Clubs has doubled: from three in 2012 to six in 2014. In order to promote integration amongst F4E families, the SC has also organises activities involving children and their families.

Annexes

GOVERNING BOARD COMPOSITION

Representing	Name	Role
Governing Board	Stuart Ward	Chair
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	Representative
Czech Republic	Pavel Pavlo Jan Kysela	Representative Representative
Denmark	Volker Naulin Jeppe Søndergaard Pedersen Lars Christensen	Representative Representative (until 24/10/2014) Representative (from 15/11/2014)
Estonia	Ergo Nömmiste Rein Kaarli	Representative Representative
Euratom	Robert-Jan Smits András Siegler	Representative Representative
Finland	Kari Koskela Tuomas Tala	Representative Representative
France	Bernard Bigot Bernard Salanon	Representative Representative
Germany	Harald Bolt Beatrix Vierkorn-Rudolph Michael Stötzel	Representative Representative (until 31/10/2014) Representative (from 01/11/2014)
Greece	Anastasios Youtsos Eleni Stavrianoudaki	Representative Representative
Hungary	Barbara Tóthné-Vizkelety Sandor Zoletnik Gabor Veres	Representative Representative (until 23/04/2014) Representative (from 24/04/2014)
Ireland	Miles Turner Bob Hanna	Representative Representative
Italy	Aldo Pizzuto Raffaele Liberali	Representative Representative
Latvia	Andris Šternbergs Maija Bundule	Representative Representative
Lithuania	Sigitas Rimkevičius Stanislovas Žurauskas	Representative Representative
Luxembourg	Léon Diederich	Representative
Malta	Ian Gauci Borda	Representative
Poland	Paulina Styczen Łukasz Ciupiński	Representative Representative
Portugal	Pedro Cabrita Carneiro Carlos Varandas	Representative Representative
Romania	Florin Buzatu Florin Spineanu	Representative Representative
Slovak Republic	Stefan Matejcik Jozef Pitel	Representative Representative
Slovenia	Jože Duhovnik Andrej Trkov Igor Lengar	Representative Representative (until 11/03/2014) Representative (from 12/03/2014)
Spain	Luis Eduardo Ruiz López de la Torre Fernando Ballestero Joaquín Sánchez Sans	Representative (until 20/03/2014) Representative (from 21/03/2014) Representative and Vice-Chair
Sweden	Pär Omling James Drake	Representative Representative
Switzerland	Xavier Reymond Minh Quang Tran Ambrogio Fasoli	Representative Representative (until 01/09/2014) Representative (from 03/09/2014)
The Netherlands	Cor Katerberg Tony Donné Wim Koppers	Representative and Vice-Chair Representative (until 29/04/2014) Representative (from 30/04/2014)
United Kingdom	Steve Cowley Alison Wall Jane Nicholson	Representative Representative (until 20/11/2014) Representative (from 21/11/2014)

BUREAU COMPOSITION

Member	Name	Role
GB	Stuart Ward	Chair
Bureau	Joaquín Sánchez Sans	Vice-Chair
Bureau	Cor Katerberg	Vice-Chair
France France	Bernard Bigot Bernard Salanon	Representative Representative
Euratom	András Siegler Andrea Carignani de Novoli	Representative Representative
Chair of Executive Committee Chair of Audit Committee	Lisbeth Grønberg Beatrix Vierkorn-Rudolph	Representative Representative (until 31 October 2014)

ADMINISTRATION AND FINANCE COMMITTEE (AFC) COMPOSITION

Representing	Name	Role
AFC	Cor Katerberg	Chair
France	Thierry Brosseron	Representative
Spain	Guadalupe Córdoba Lasunción	Representative
Belgium	Chantal Cortvriendt	Representative
Germany	Nicolas Hirsch	Representative
UK	Eric Hollis	Representative
Finland	Juha Linden	Representative
Slovenia	Simon Ošo	Representative
Portugal	Silva Carlos	Representative
Austria	Monika Fischer	Representative
Denmark, Sweden, Switzerland	Jeppe Søndergaard Pedersen	Representative
Euratom	Marina Zanchi Marc Pipeleers	Representative Representative

EXECUTIVE COMMITTEE COMPOSITION

Representing	Name	Role
Executive Committee	Lisbeth Grønberg	Chair
Ad Personam	Michel Bédoucha	Member (from 1/1/2014)
Ad Personam	Maciej Chorowski	Member
Ad Personam	Itziar Echeverría	Member
Ad Personam	Fabrizio Felici	Member
Ad Personam	Simone Gruenhoff	Member (from 1/1/2014)
Ad Personam	Julio Monreal	Member (from 2/5/2014)
Ad Personam	Herkko Plit	Member
Ad Personam	Don-Pierre Pompei	Member
Ad Personam	Federica Porcellana	Member (from 1/1/2014)
Ad Personam	Pilar Ramiro	Member
Ad Personam	Herman ten Kate	Member
Ad Personam	Pierre Van Doorslaer	Member
Euratom	Carles Dedeu Fontcuberta Pascal Petit Giancarlo Sordon	Representative and Vice-Chair

AUDIT COMMITTEE COMPOSITION

Representing	Name	Role
Audit Committee	Beatrix Vierkorn-Rudolph	Chair (until 31/10/14)
Ad Personam	Brian Gray	Member (from 02/05/14)
Ad Personam	Jean-Marie Haensel	Member (30/06/2014)
Ad Personam	Thomas O'Hanlon	Member (01/05/2014)
Ad Personam Ad Personam	Andreas Pott Christian Scherf	Member (01/07/2014) Member (01/07/2014)
Ad Personam	Jurij Von Kreisler	Member (30/06/2014)
Ad Personam	Paul Webb	Member

TECHNICAL ADVISORY PANEL

Representing	Name	Role
Technical Advisory Panel	Joachín Sánchez Sans	Chair
Ad-Personam	André Grosman	Vice Chair
Ad-Personam	Wolfgang Biel	Member
Ad-Personam	Martin Cox	Member
Ad-Personam	Flavio Crisanti	Member
Ad-Personam	Horacio Fernandes	Member
Ad-Personam	Pascal Garin	Member
Ad-Personam	Marek Rubel	Member
Ad-Personam	Vincent Massaux	Member
Ad-Personam	Mathias Noe	Member
Ad-Personam	Noud Oomens	Member
Ad-Personam	Nawal Prinja	Member

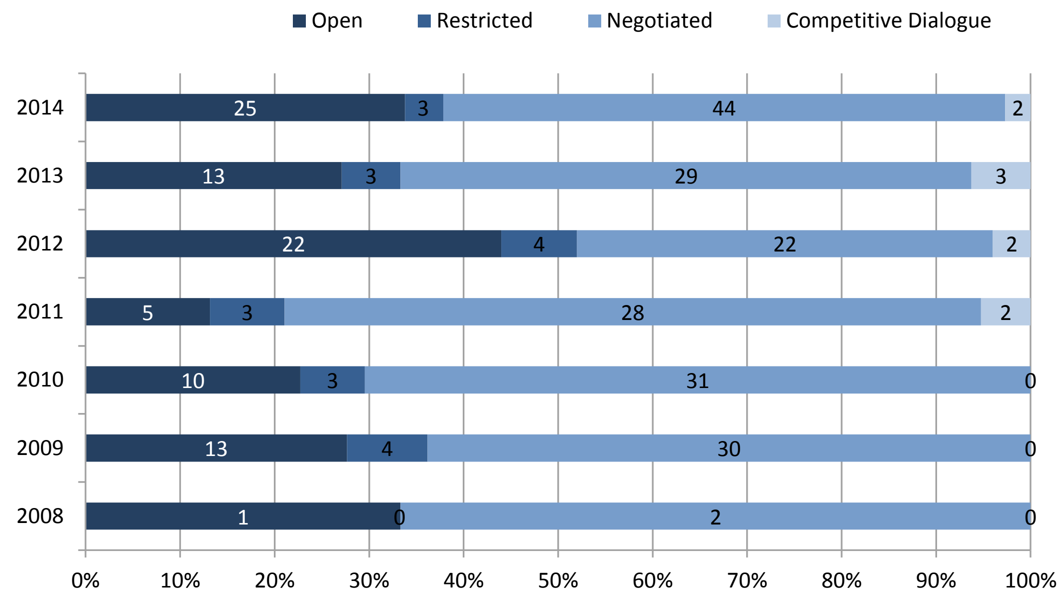
ITER PROCUREMENT ARRANGEMENTS

Title	Credit (kIUA)	Signature Date
In-Vessel Viewing System	6.8	December 2014
Electron Cyclotron Control System	1.4	December 2014

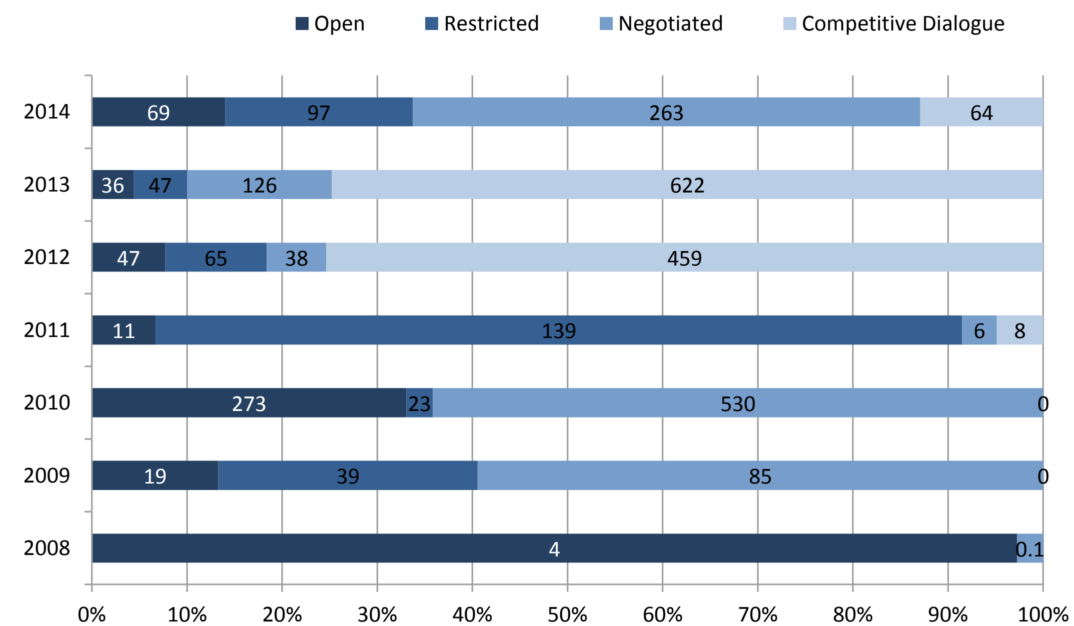
CONTRACTS AND GRANTS

Operational Procurement Contracts

Summary by Type of Procedure



Contracts awarded by procurement procedure (number)



Contracts awarded by procurement procedure (EUR million)

Negotiated procedures (above EUR 250,000)

	Number	Value (EUR)
Negotiated above threshold	11	261,285,939

Awarded Contracts (* Negotiated Procedures)

Reference	Title	Contractor
F4E-OPE-614*	ASG Electrical Breakers for HPGL Mechanical Tests	ASG SUPERCONDUCTORS
F4E-OPE-532 LOT 1*	Follow-on OPE-489	SOC METALLURGICA MINOTTI SAS
F4E-OPE-616*	Performance of the Static Tests “Collaudo” prescribed by DPR 380/2001 for new NBTF structures	SiSt
F4E-OPE-600*	77 K tensile tests of JT-60SA TF Coils Casings Forged Material	RTM BREDA S.R.L.
F4E-OPE-0574*	ECH Control System Requirements Specifications Amendment No. 1 of OPE-501 (Art. 100.2g(i))	Instituto di Fisica del Plasma (IFP); Consiglio Nazionale del Ricerche (CNR)
F4E-OPE-0562*	Tokamak Complex Fire Analysis	EFECTIS FRANCE S.A.S.
F4E-OPE-532 LOT 3*	Follow-on OPE-489	CSN Carl Schreiber GmbH
F4E-OPE-599*	Endoscope for Inspections	OLYMPUS IBERIA SAU
F4E-OPE-579*	316L AUSTENITIC STAINLESS STEEL FOR FIRST WALL PANEL PROTOTYPES	ROLF KIND GMBH
F4E-OPE-541*	Inclusion of the code GRAY into the JINTRAC suite of code	Instituto di Fisica del Plasma (IFP) & Consiglio Nazionale delle Ricerche (CNR)
F4E-OPE-554*	Metrology Equipment GapGun	MAS METROVISION
F4E-OPE-609*	Neutronics Close Support Services	IDOM
F4E-OPE-612*	Assessment of Activated Corrosion Products in the Electron Cyclotron Upper Launcher	STUDSVIK
F4E-OPE-592*	Supply of JT-60SA TF Coils Prototype Double Pancake for exhibition purposes	ASG Superconductors S. p. A.
F4E-OPE-0561*	Procurement of Electron Cyclotron Diamond prototype disks - DM	Diamond Materials GmbH
F4E-OPE-589*	First Wall Hip Simulation Services	Centre International de Metodes Numérics en l´Enginyeria (CIMNE)
F4E-OPE-619*	Additional services in the field of occupational Health & safety and Direction of Work for the NBTF (Amendment to OPE-518)	URS ITALIA S.P.A
F4E-OPE-0575*	Quality and surveillance support inspectors for the wds holding and emergency tanks manufacturing follow up	Bureau Veritas Iberia SL
F4E-OPE-543*	Metrology Equipment	Hexagon Metrology S.A.
F4E-OPE-532 LOT 2*	Follow-on OPE-489	KME Germany GmbH & Co, KG
F4E-OPE-621*	Insurance Brokerage Services for the TF Coils Insertion	March JLT Correduria de Seguros y Reaseguros, SA.
F4E-OPE-0488*	Destructive analysis of small-scale beryllium mock-ups of the NHF FW panels	Commissariat à l'énergie atomique et aux énergies alternatives (CEA)
F4E-OPE-0580*	Expertise Support on JT-60SA TF Conductor Hydraulic Tests	CEA (COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES)
F4E-OPE-0573*	Consultancy services on construction and erection all risk policy (CEAR)	SIACI SAINT HONORE
F4E-OPE-610*	Engineering assessment of the ITER Port Plug conceptual installation & removal scheme	APCO TECHNOLOGIES SA
F4E-OPE-0566*	Customisation and Provision of Remote Data Access Technology to REC project	CONSORZIO RFX
F4E-OPE-594*	CuCrZr for all in 443	Le Bronze Industriel SAS
F4E-OPE-0584*	Phisics Analysis for Plasma Engineering Studies: Simulations of energy loads and their mitigation during disruptions and runaway electron formation in ITER	KIT
F4E-OPE-0558	Manufacturing of Continuous External Rogowski (CER) coils for ITER	AXON' CABLE S.A.S. (GROUP LEADER) AND SGENIA SOLUCIONS S.L
F4E-OMF-555-01	Provision of support services to the F4E Dual Use Export Control Compliance Programme	ALTER TECHNOLOGY TUV NORD S.A.U.
F4E-OPE-517	Technical Support to Fusion for Energy (F4E) to follow up the Design, Manufacturing and Qualification of a High Heat Flux Test Facility for In-Vessel Components	AREVA NP
F4E-OMF-0545-01	Technical and legal assistance of an “autorité de surêté nucléaire” agreed notified body on nuclear pressure equipment for the test blanket module systems	APAVE SUDEUROPE SAS
F4E-OPE-551	Procurement of Warm Helium Regeneration Lines	Criotec Impianti S.r.l
F4E-OPE-0602*	QA and Surveillance support Inspectors for the ITER project	Bureau Veritas Iberia SL
F4E-OMF-0466 Contractor 1	Nuclear Analysis	United Kingdom Atomic Energy Authority
F4E-OMF-0468	Metrology Support Services	SETIS GROUPE DEGAUD(FRANCE) AS GROUP LEADER WITH PES (UNITED KINGDOM) AS MEMBER
F4E-OPE-522	Gaseous Helium Storage Vessels	A. Silva Matos Metalomecânica S.A.
F4E-OMF-0508 (new 402) Contractor 1	Engineering support in the area of electromagnetic and electro-mechanical analysis of ITER components.	NUMERICAL ANALYSIS TECHNOLOGIES S.L. (NATEC)
F4E-OMF-503 LOT1 -01	Seismic analysis and design of building and mechanical components of ITER facility	ESTEYCO SAP
F4E-OMF-503 LOT 2 -01	Dynamic analysis and design of building and mechanical components of ITER facility	IDOM INGENIERIA y CONSULTORIA SAU

F4E-OMF-503 LOT 3 -01	Structural analysis and design of building and mechanical components of ITER facility	ESTEYCO SAP
F4E-OFC-413 LOT 4	Irradiation and post irradiation characterization of materials for development of fusion energy. - LOT 4	Studsvik Nuclear AB (SE)
F4E-OMF-436 LOT 4 -01	Cost Management Support	Project Time & Cost International Ltd.
F4E-OMF-436 LOT 1 -01	Provision of Project Management Support to F4E	Oxand Ltd.
F4E-OFC-413 LOT 2	Irradiation and post irradiation characterization of materials for development of fusion energy. - LOT 2	TÛV Rheinland Industrie Service GmbH (DE) ; SCK–CEN (BE)
F4E-OFC-413 LOT 3	Irradiation and post irradiation characterization of materials for development of fusion energy. - LOT 3	Studsvik Nuclear AB (SE)
F4E-OPE-544	JT-60SA TF Coils Replacement Forgend Material	R. KIND GmbH
F4E-OFC-413 LOT 1	Irradiation and post irradiation characterization of materials for development of fusion energy. - LOT 1	Nuclear Research and Consultancy Group (NRG)
F4E-OPE-447*	Procurement of an industrial 1MW, CW gyrotron prototype at 170GHz	THALES ELECTRON DEVICES S.A.
F4E-OFC-531*	NBTF Diagnostics	Consorzio RFX
F4E-OPE-0520	Supply of MITICA Vacuum Vessel	De Pretto Industrie S.r.l
F4E-OPE-443 LOT 1*	Manufacture of a Full Scale prototype of the ITER FW Panel LOT 1	ATMOSTAT, ALCEN
F4E-OFC-280*	Framework contract for neutral beam test facility control, interlock and safety	Consorzio RFX
F4E-OMF-557 LOT 1 -01	Support QA/QC follow-up Inspectors for the ITER Project and support on QA activities	INSTITUTO DE SOLDADURA E QUALIDADE - ISQ
F4E-OPE-443 LOT 3*	Manufacture of a Full Scale prototype of the ITER FW Panel LOT 3	IBERDROLA (ES), AMEC (UK), Mecanica Industrial Buelna (ES)
F4E-OPE-443 LOT 2*	Manufacture of a Full Scale prototype of the ITER FW Panel LOT 2	AREVA NP
F4E-OPE-0568	PF Coils site & Infrastructure Manager	DALKIA-VEOLIA Consortium
F4E-OPE-463*	PF Winding Tooling 1	CONSORTIUM SEA ALP ENGINEERING
F4E-OPE-083	High Voltage Deck and Bushing	SIEMENS AG
F4E-OFC-433	Integration design of diagnostics into ITER ports	IDOM INGENIERIA Y CONSULTORIA S.A.
F4E-OPE-507*	Amendment 7 to OPE-058: Additional services provided by the Architect Engineer	Consortium Engage (Assystem France SAS, WS Atkins International LTD, IOSIS Industries, Empresarios Agrupados Internacional)
F4E-OMF-340 LOT 1 -01	Multiple Framework Contracts in cascade for Remote Handling Systems (RHS) under nuclear environment: Divertor RHS, Cask and Plug RHS, Neutral Beam Cell RHS	ASSYSTEM UK
F4E-OPE-428	Design, Supply, Installation & Commissioning of the Electrical Power Distribution (TB06)	FERROVIAL AGROMAN S.A.
F4E-OPE-414*	Cold test of the TF Winding Pack and the Winding Pack insertion into the Coil Cases	SIMIC S.p.A.

Administrative Procurement Contracts

Summary by type of procedure

Type of Procedure	Number	Value (kEUR)
Open	2	6,000,000
Restricted	0	0
Negotiated	2	1,050,000
Re-opened competition implementing a Framework		0
Total	**6**	**7,050,000**

Negotiated Procedures above EUR 60,000

Reference	Title	Contractor	Type
F4E-AMF-0576.01*	Legal services in the field of Construction Contracts	Gide Loyrette Nouel	Framework Service Contract
F4E-AMF-0576.02*	Legal services in the field of Construction Contracts	Norton Rose	Framework Service Contract
F4E-AMF-0576.03*	Legal services in the field of Construction Contracts	Bird & Bird	Framework Service Contract

Awarded Contracts

Reference	Relocation Services	Type
F4E-OPE-0583	Services Provided by a Member of the IAIPS Expert Group	Negotiated
F4E-ADM-0547	Data Centre Services (ex-Disaster Recovery)	Open
F4E-ADM-0549	Software Acquisition Channel (SACHAII)	Open
F4E-AMF-0576.01	Legal services in the field of Construction Contracts	Negotiated
F4E-AMF-0576.02	Legal services in the field of Construction Contracts	Negotiated
F4E-AMF-0576.03	Legal services in the field of Construction Contracts	Negotiated

Grants

Grants (* Unique Beneficiary)

Reference	Agreement Description	Beneficiary
F4E-GRT-615	Amendment to GRT-161	ECHUL-CA (Instituto di Fisica del Plasma-CNR & IPP)
F4E-GRT-403	Development and design of High Resolution Neutron Spectrometer	The Henryk Niewodniczanski Institute of Nuclear Physics of the Polish Academy of Academy of Sciences (IFJ PAN) Uppsala University (UU)
F4E-GRT-553	Design and Development of the EU gryrotron	EPFL, KIT, HELLAS, IFP-CNR
F4E-GRT-0514 ACTION 1	Remote Handling Pipe and Lip Seal Maintenance R&D	United Kingdom Atomic Energy Authority - Culham Centre for Fusion Energy (CCFE)
F4E-GRT-542	Upgrade of the Tritium Transport Simulation Tool Based on ECOSIMPRO and Generation of New Simulation results.	CIEMAT, Empresarios Agrupados

Declaration of Assurance

I, undersigned, Henrik Bindslev, 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 2014 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 (Sub) Delegation as well as the results of F4E management supervision functions, the annual external assessment of F4E and ex-post controls.
- Without qualifying this reasonable assurance, I confirm that the system of internal control is being further enhanced and improved in order to appropriately mitigate the risks observed by the European Court of Auditors in the “Emphasis of Matter” section of their annual report 2013:
  - 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 has not yet implemented a system at contract level to regularly monitor the cost deviations;
  - o Neither of these elements calls into question the legality and regularity of the underlying transactions of the 2013 annual accounts.
- Confirm that those risks do not question the legality and regularity of the underlying transactions in relation to the 2014 annual accounts.
- Recognise the needs to mitigate those risks under the control of F4E by addressing them through the following actions:
  - o Support the ITER International Organisation in developing a realistic and sound revised schedule that takes into account the available resources and the cost dimension which are closely related;
  - o Further developing the F4E existing system to centrally monitor the cost deviations in a homogeneous manner;
  - o Continue to pursue the cost containment 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.

Henrik Bindslev
Director of Fusion for Energy
26 February 2015

Analysis and Assessment by the Governing Board

INTRODUCTION

Article 43 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 15 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 2014 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 43 of the Financial Regulation.

2. Welcomes the overall achievements presented in the 2014 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.

4. Notes the progress that has been made with the ITER buildings construction, in particular the fast finishing of the Tokamak Complex slab after achieving successfully compliance with the requirements of the regulator. However the pace of the construction has been slow than planned, for a variety of reasons, and is a source of the delay in the project. Being aware of cost and schedule risks, the Governing Board monitors progress on the building with F4E management on a regular basis.

5. Welcomes the significant progress in nearly all ITER components under F4E responsibility. In particular it is worth noting the successful insertion of the TF double pancakes into the radial plates, achieving record accuracies and overcoming one of the key technological challenges in the construction of ITER. It is also worth remarking on the successful test of the short pulse 1MW gyrotron, which confirms the European capabilities in this technology.

6. Notes with concern the problems that have arisen during 2014 in the fabrication of the Vacuum Vessel, in particular the difficulties with the welding procedures, the non-conformity of several steel plates, the overall additional delays in the component schedule and the resulting budget risk.

7. Notes that cost containment remains challenging and that further steps are needed. This remains a priority for both F4E and the Governing Board.

8. Welcomes the progress of the Broader Approach projects including the delivery of key JT60-SA components. The successful installation of the injector in Rokkasho for the IFMIF EVEDA is noteworthy, as is the progress with the Linac, RFQ, diagnostics and characterization of the Lithium target. The use made by both European and Japanese teams of the Helios computer is very praiseworthy and the upgrade that will take place shortly will enhance the scientific output even more.

For the Governing Board

Stuart Ward
Chair of the F4E Governing Board
9 June 2015

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

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
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
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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