iter

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ITER ORGANIZATION
2015 ANNUAL REPORT

Digging starts in October on the site of the ITER cryoplant. Cryogenic technology will be used extensively at ITER to create and maintain low-temperature conditions for the magnet and vacuum pumping systems.

January
- First Highly Exceptional Load travels along the ITER Itinerary

March
- Extraordinary ITER Council confirms Bernard Bigot as the new ITER Director-General
- 2015 edition of the ITER Business Forum

May
- First Open Doors Day of the year
- Fourth edition, ITER Robots contest
- Two-day press event

June
- Seventeenth ITER Council
- US-delivered transformer becomes the first plant component installed on site

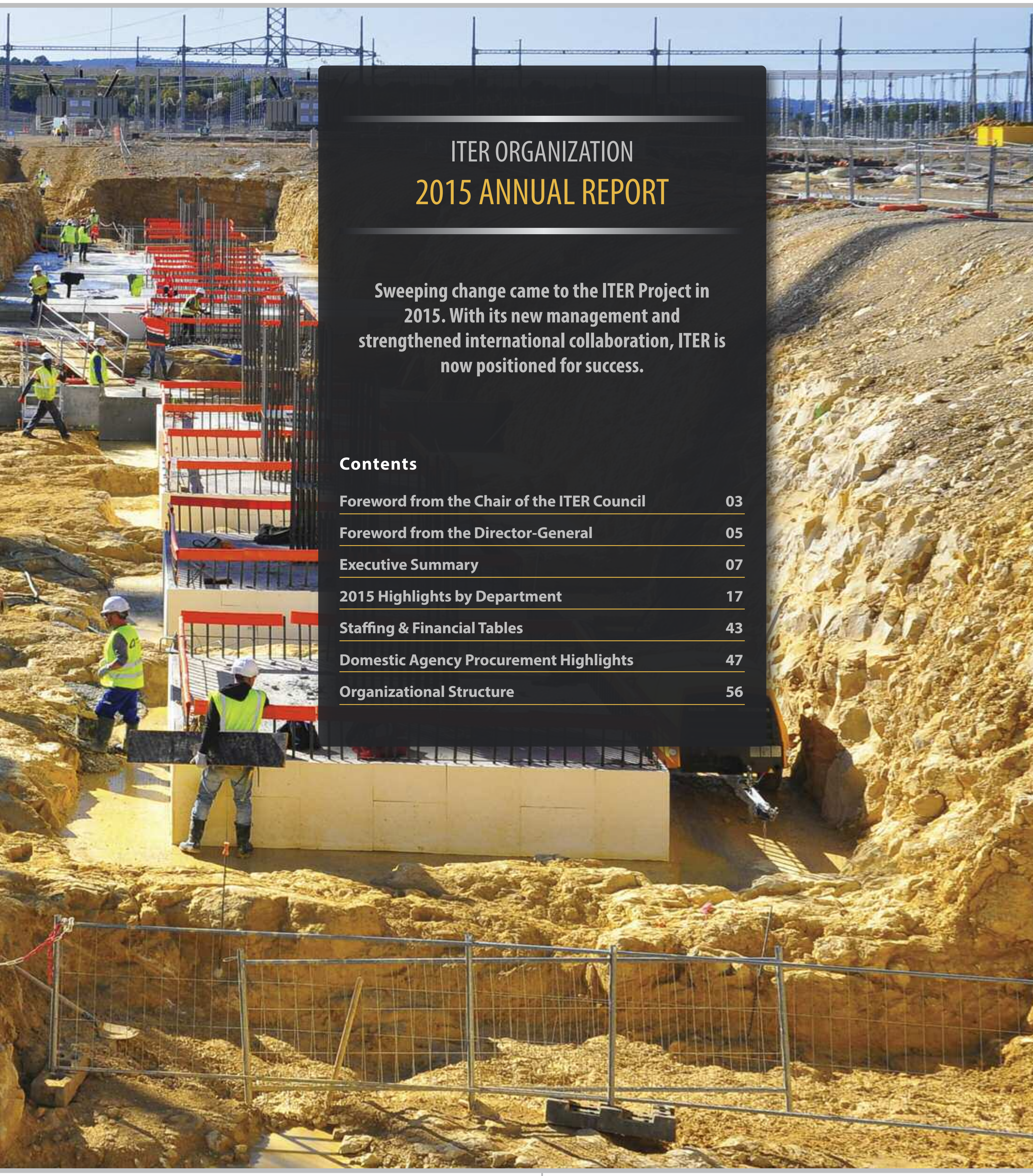
July
- Work begins on the upper basement level (B1) of the Tokamak Complex
- Project Teams created for building construction and vacuum vessel manufacturing
- Call for nominations launched for the support of a Construction Management-as-Agent contractor (CMA)

September
- Final Conductor Meeting marks end of eight-year campaign to procure ITER superconductors
- The metal structure of the Assembly Hall is completed
- Finalization of Assembly Hall structure

October
- Second Open Doors Day of 2015
- More than 100,000 people have visited the worksite since tours opened in 2007

November
- Updated schedule presented at the Eighteenth ITER Council

December
- First machine components delivered (460 tonnes of cryostat segments)
- ITER is at the United Nations Conference on Climate Change (COP21)
- First components installed in neutral beam test facility PRIMA
- 91.2% of Procurement Arrangements signed (in value)



ITER ORGANIZATION

2015 ANNUAL REPORT

Sweeping change came to the ITER Project in 2015. With its new management and strengthened international collaboration, ITER is now positioned for success.

Contents

Everything goes according to plan for the first Highly Exceptional Load to travel along the ITER Itinerary. The 87-tonne electrical transformer procured by the US for ITER's steady state electrical network reaches the site on 14 January.

FOREWORD FROM THE CHAIR OF THE ITER COUNCIL

In my two years as ITER Council Chair, it has been rewarding to see the extensive efforts made by the ITER Organization and Domestic Agencies to improve project performance and culture – first in response to recommendations of the 2013 Management Assessment, and most recently in accordance with the Action Plan of the new ITER Director-General, Bernard Bigot.

ITER is a first-of-a-kind project in many ways, not only in the unique scale of its fusion science and technology, but also in the fundamentally international makeup of its organization.

In ITER, the central ITER Organization is responsible for the overall design, licensing, construction, commissioning, and finally operation of the facility, while the seven Domestic Agencies are given the budget by the ITER Members to provide "in-kind" contributions in the form of buildings, structures, components and systems, and also to contribute "in-cash" to the operation of the central organization.

This international makeup leads to the incomparable richness of the project, as specialists from 3 continents and 35 countries pool their expertise and experience. But it has also added a level of complexity to day-to-day management and, in some cases, to the misalignment of goals/incentives that has led to project delay and cost increases.

Robert Iotti
Chair of the ITER Council

Within the parameters of the ITER Agreement, and in respect of each Member's constraints, the ITER Organization and the Domestic Agencies are learning to reinforce cooperation and tighten alignment. As you will see in this report, joint efforts have been made to complete the design in critical areas, accelerate building construction and the fabrication of components, and improve project and safety culture. There is a new "can-do" spirit that goes along with this increased cooperation, and which represents a positive change for the project.

Some of the reforms are paying immediate dividends; some will require more time to be implemented completely and for results to show. Throughout this transitional period the ITER Council has worked to accompany positive reform by improving its own effectiveness and efficiency.

The most striking example of tangible progress over the past year was the development of an updated realistic schedule based on a vast project-wide fact-finding exercise. Requiring an unprecedented level of cooperation between the ITER Organization and the Domestic Agencies, this schedule exercise has resulted in a detailed roadmap for the future which, as it becomes optimized to reflect budget constraints by the various Members, can be fully supported by all. The Council plans to complete its review and reach agreement on the overall schedule through First Plasma by June.

With good management of the project and the updated schedule and resource profile, there are no showstoppers to building ITER. My best wishes accompany all those who are working daily on one of the most ambitious scientific endeavours of our time. Let us not forget that what 35 nations are building in southern France is not just a tokamak, but a new energy future for all of humanity.

I thank all of the Members for giving me the privilege of serving as Council Chair for the past two years.

The ITER construction platform in September 2015.
Photo: © MatthieuCOLIN.com

FOREWORD FROM THE DIRECTOR-GENERAL

In March 2015, I accepted the extremely challenging directorship of the global ITER Project with one idea in mind: to complete the construction of the complex ITER facility as soon and as cost effectively as possible in order to fulfil the expectations of the seven ITER Members and the public.

In the Action Plan that I submitted to the ITER Council three priorities were highlighted: a fundamental restructuring of the integrated way in which the ITER Organization and the seven Domestic Agencies work together, deep organizational reform for more efficient and responsive decision making, and the establishment of a detailed updated schedule with corresponding resource and staffing profiles.


Bernard Bigot
ITER Organization Director-General

The way in which all project actors pulled together around these important reforms in 2015 – while sustaining improved project performance – is already a sign of the new project culture that is emerging at ITER.

Just over one year later, the Action Plan has been largely implemented and the updated schedule and resource estimates have been reviewed by the ITER Council as well as by the independent experts of the ITER Council Review Group. Performance against the milestones established by the ITER Council for 2016 has been steady and strong. Following the review by the ITER Council in 2016 of our schedule proposal to First Plasma and then deuterium-tritium operation we expect – before the end of 2016 – to have a clear roadmap for the future, a new Baseline that has the full validation of all ITER Members.

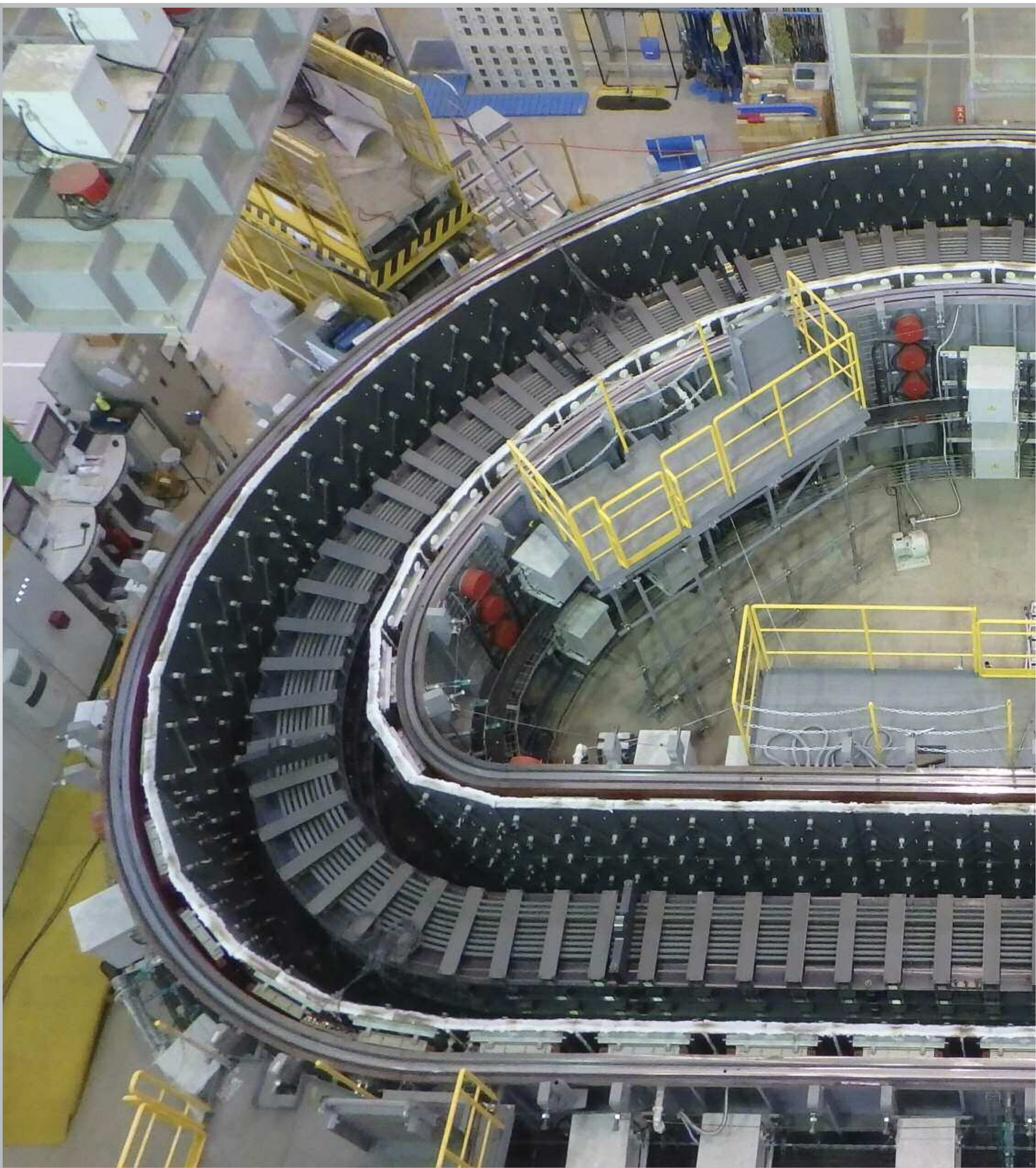
The push to finalize the design of critical systems in 2015 led to an increased pace of work on the construction platform, in particular for the Tokamak Complex where the first basement level has emerged and work is underway on the bioshield and cryostat crown support system. The frame of the Assembly Building was completed and preparations initiated for the installation of the massive overhead cranes that are needed for the start of machine assembly. In other parts of the platform, building has begun on a large number of plant facilities and technical areas.

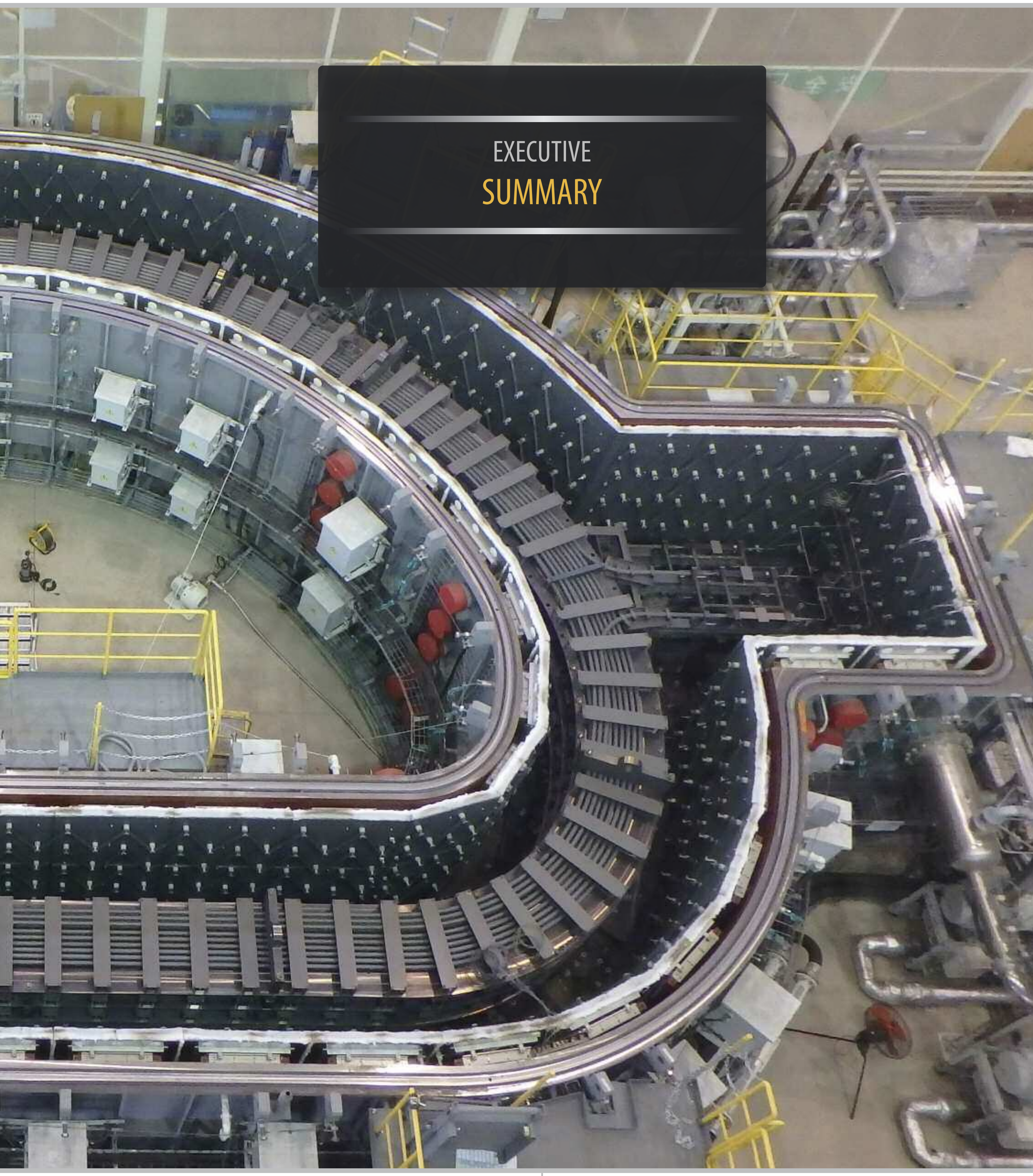
A major construction phase milestone was achieved in December, as the first manufactured components for the ITER Tokamak reached the site. While in the past years industrial contractors in the ITER Members were concentrating on qualification prototypes, today they are fabricating the production elements for the ITER machine and plant. We estimate that for the components and systems required for First Plasma, 89 percent of the design work and 24 percent of the overall manufacturing of the components were completed (based on ITER Unit of Account value credits) at the end of 2015.

In its renewed commitment to progress, ITER has benefitted from the expert guidance of the ITER Council and its advisory bodies, which reunite ITER Member specialists in science, technology and project management. Much is owed also to the strong leadership of Dr Robert Iotti who, as Chair of the ITER Council during the years 2014 and 2015, was a true force for change during a transformative time. We are all grateful for his decisive contribution to ITER progress.

Our new and tangible momentum reflects an extraordinary degree of commitment and collaboration by all parties. Many areas still require improvement, including even greater integration between ITER Organization and Domestic Agency teams as we move toward the start of assembly, but I feel confident today that the ITER Project is back on the path to success.

Toroidal field double pancake windings must be heat treated to react tin and niobium to form the superconducting compound Nb3Sn. This heat treatment furnace in Japan has already entered production, successfully treating seven double windings.
Photo: ITER Japan





EXECUTIVE SUMMARY

Sweeping change came to the ITER Project in 2015. Under the helmsmanship of a new Director-General deep organizational reform was implemented, critical elements of the design were stabilized to permit suppliers to move forward, and the interaction between ITER Organization and the Domestic Agencies was radically redefined. A new way of conjointly "owning" the project – feeling responsible for global results and not just one area of competence – has begun to permeate the project culture, an attitude that was nowhere more visible than in the project-wide effort to update the schedule. The result is a path forward that has been presented to ITER stakeholders for review.

This re-focusing of energy and intent comes at a crucial moment for ITER. As worksite teams start on the second level of the massive Tokamak Complex, manufacturing is underway in the factories of the ITER Members on all of the components and systems required for First Plasma. In 2015 the first large-scale convoys of ITER components travelled along the ITER Itinerary from the Mediterranean Sea to Saint-Paul-lez-Durance, the first elements of the ITER plant were installed on the construction platform, and the very first Tokamak components reached ITER.

In November 1985, the idea of a large international collaboration on fusion was given a decisive political push by world leaders Mikhail Gorbachev and Ronald Reagan. Thirty years later, the initiative to realize the "widest practicable development of international cooperation" in obtaining a virtually inexhaustible form of energy is nearing the start of its assembly phase, when the one million components supplied by the ITER partners will be aggregated into the world's largest fusion plant. With its new management and strengthened international collaboration, ITER is positioned for success.

Organization

A year of change

The November 2014 nomination of Bernard Bigot as the new Director-General of the ITER Organization, succeeding Professor Osamu Motojima who had led the ITER Project since 2010, was unanimously confirmed by all Members on 5 March 2015 in an extraordinary meeting of the ITER Council in Paris (IC-Ex/03.15). In appointing Dr Bigot, the Council also endorsed the Action Plan he proposed to address critical deficiencies in the management of the project that had been identified in the 2013 Management Assessment.

The Action Plan detailed the organizational changes needed to put the project back on track, such as improved collaboration between the central team located in France and the seven Domestic Agencies, reduced bureaucracy, and the establishment of strong transversal offices for central integration, project control and quality assurance. It also committed to the establishment of an updated resource-loaded schedule through First Plasma and deuterium-tritium commissioning – one that would be built on realistic, verifiable data and that would have the explicit commitment of all stakeholders.

The reform of the general processes and management of the ITER Organization began immediately. Senior managers were reduced in number from seven to three; recruitment was launched for the leaders of newly created transversal units; and a Central Team Management Board (CTMB) was formed to assist the Director-General in his responsibility as Chief Executive Officer of the ITER Organization. Two Deputy Director-General positions were created to assist the Director-General in his overall responsibilities: the Chief Operating Officer, responsible for the technical coordination of ITER Organization and Domestic Agency activities in the areas of design, manufacturing, construction, installation, testing, commissioning and operation; and the Relations Coordinating Officer, responsible for overseeing and coordinating the activities related to project control, nuclear safety, security, quality assurance and assessment, and the ITER Organization administrative functions of finance, procurement and human resources. The full management team was in place by November.

Other measures were taken to freeze the design of critical systems and buildings in order to staunch the flow of project change requests affecting work progress. A central Reserve Fund was established under the Director-General's management to empower the quick resolution of project change requests, and joint ITER Organization-Domestic Agency Project Teams were created in critical

Bernard Bigot, from France, becomes the new ITER Director-General on 5 March 2015.

Twelve segments of the massive cryostat are shipped from India to ITER in 2015 -- the very first Tokamak components to reach and be stored on site.

areas to focus project resources – cutting across the traditional boundaries of department or agency – to improve performance in delivery. These measures have resulted in a project culture that is oriented towards achieving results and stemming delays to the schedule.

The Executive Project Board replaced the ITER Organization Project Board as of 5 March. Formed by the Director-General (Chair), the Deputy Director-Generals, and all Domestic Agency Heads, this executive decision-making body plays a key role in fostering a shared long-term vision. The ITER Organization and the Domestic Agencies also continue to meet regularly within the framework of Unique ITER Team weeks for the detailed examination and resolution of technical issues.

In addition to its extraordinary meeting in March, the ITER Council held two regular meetings on 17-18 June (IC-16) and 18-19 November (IC-17); the Seventeenth Meeting was the last for Council Chair Robert Iotti, who is succeeded after a two-year term by Won Namkung from Korea. The Management Advisory Committee (MAC), the Science and Technology Advisory Committee (STAC) and the Test Blanket Module Program Committee (TBM-PC) convened ahead of each Council meeting to provide support for strategic issues. The ITER Council appointed the 2015 Management Assessor in June in accordance with Article 18 of the ITER Agreement.

ITER Project Baseline

Updating the long-term schedule

Following a six-month exercise to assess the design maturity, manufacturing schedules, and installation and assembly sequences of each machine and plant component, the ITER Organization and the Domestic Agencies presented a resource-loaded schedule to the ITER Council in November.

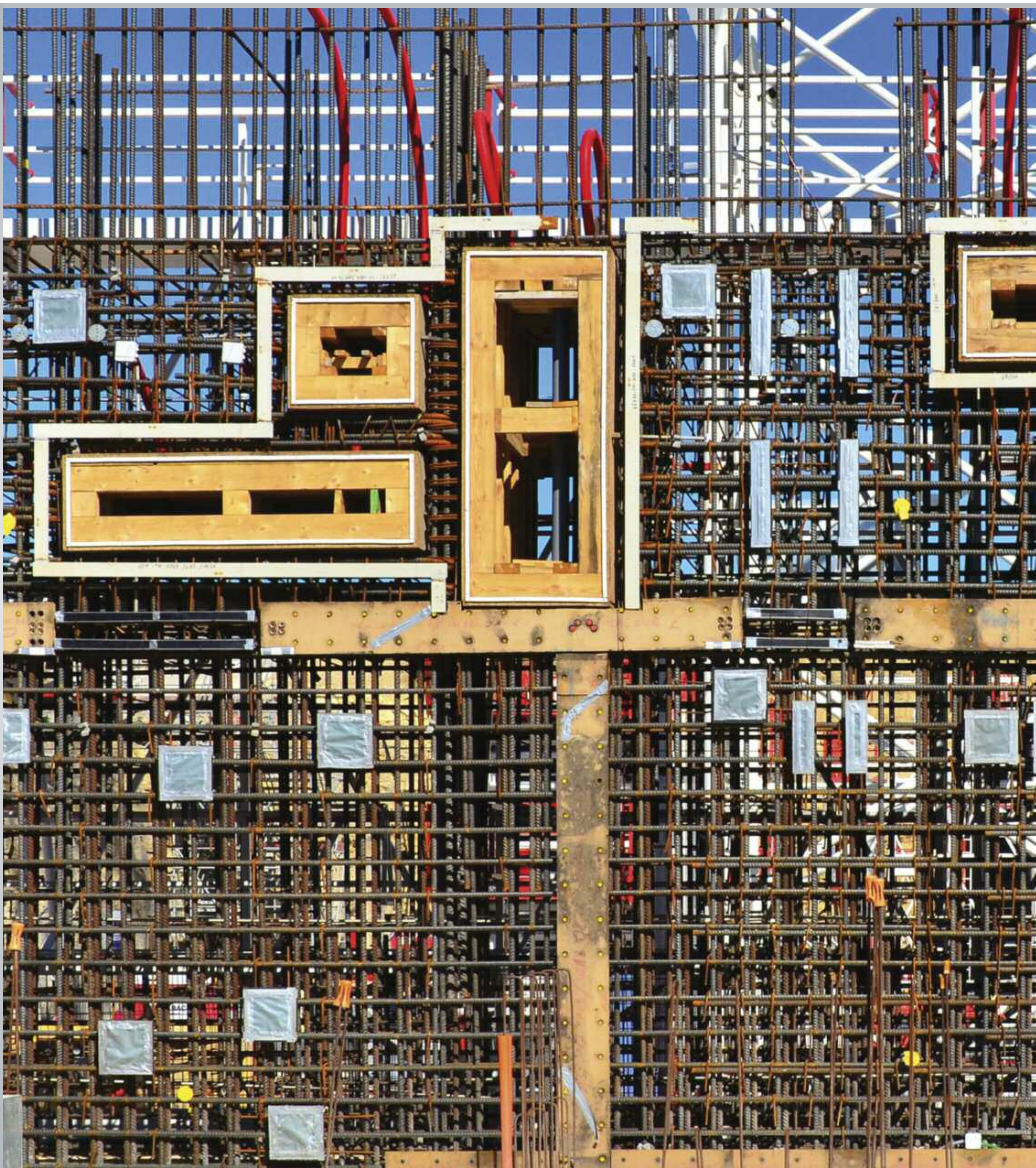
This Updated Long-Term Schedule encompasses all engineering, procurement, construction and operational activities and represents the best technically achievable path – contingent on resources – to First Plasma and deuterium-tritium operation. Council members were unanimous in their recognition of the quality of the project-wide effort and of the much-improved understanding of the scope, sequencing, risks, and costs of the ITER Project. The announced delay in the achievement of First Plasma and corresponding increases in budget and staffing requirements will now be discussed by each ITER Member.

The ITER Council has mandated an independent review of the overall schedule and associated resources and staffing plan and will consider possible additional measures for expediting the schedule and reducing costs. The appointed group of independent experts plans to complete these reviews and reach agreement on the overall schedule through First Plasma in time for consideration by the ITER Council at its June 2016 meeting.

With the review pending, Council members approved a schedule and milestones for the 2016-2017 period as well as the re-allocation of funding and the recruitment of necessary staff to enable adherence to the schedule. Project performance will be monitored against 29 high-level milestones underpinned by thousands of activities referenced in the proposed schedule. The first milestone – the delivery of cryostat segments by India – was achieved ahead of schedule in December.

The ITER Organization is introducing industry-standard tools and increasing staff recruitment in the key areas of systems engineering, configuration management and project control. The approach to risk management is also maturing, with a focus on systematically identifying risks and opportunities and developing risk mitigation plans instead of accepting further delay and consuming contingency. Two areas continue to constrain the schedule: the construction of the Tokamak Complex and the fabrication of the vacuum vessel. Progress in these critical areas is monitored closely in order to be able to take any needed mitigation action as early as possible.

These graphic shapes mark out the areas reserved for embedded plates. Tens of thousands of these plates have been designed into the walls, ceilings and floors of the Tokamak Complex to anchor equipment.



Construction

First basement level for the Tokamak Complex

The push by the new Director-General to arrest the flow of continuous changes and freeze the designs of critical buildings by mid-year effectively increased the pace of construction works in 2015. At the B2 basement level of the Tokamak Complex, the walls and columns of the Diagnostic, Tokamak and Tritium buildings and a 200° segment of the ITER bioshield were realized through more than 250 individual concrete pours. The Assembly Hall roof was lifted and secured into place, completing the structure of the building, and construction activities progressed for the site service, radio frequency heating, cleaning and cryoplant facilities. Work is underway on close to a dozen construction sites on the platform.

The Buildings, Infrastructure & Power Supplies (BIPS) Project Team was created in July to coordinate the delivery of the buildings and technical infrastructure of the ITER site with top efficiency. This tightly integrated ITER Organization-European Domestic Agency team worked jointly to oversee building activities, accelerate decision making, avoid work duplication, and recover schedule delays. Under the BIPS Project Team's coordination, the construction design of the Tokamak Complex advanced level by level and that of all other buildings progressed.

The first Highly Exceptional Load (HEL) to travel along the ITER Itinerary in January – an 87-tonne electrical transformer – also became the first plant component to be installed in its permanent position on the ITER platform. Fifteen HEL convoys crossed the Itinerary during the reporting period – each one the fruit of complex coordination involving ITER's global logistics provider, the procuring Domestic Agencies, the ITER Organization, Agence Iter France and French authorities.

As part of activities underway to prepare for the assembly and installation phase, the ITER Organization launched a call for tender to select the contractor that will help to plan, manage and supervise the assembly and installation activities on the site – the Construction Management-as-Agent (CMA). The strategy for the management and execution of assembly works, a Construction Master Schedule detailing all processes for the assembly and installation of each component, and a full cost estimate of all works were also completed.

Licensing

Building and manufacturing according to regulations

Technical exchanges continued with the French Nuclear Regulator (ASN) in 2015 on prescriptions related to the ITER stress test, an assessment conducted to study the resistance of the installation in the face of extreme external events. The ASN continued to monitor the fabrication of components and the construction of buildings that have a role to play in the safety of the ITER installation, performing inspections on the fabrication of the vacuum vessel in Korea and on the manufacturing, transportation and storage of the tokamak cooling water drain tanks delivered by the US. The inspectors also made three visits to the ITER site to observe ongoing civil work.

As part of its obligations and responsibilities as the first nuclear operator of a fusion facility, the ITER Organization pursued efforts to install a project-wide safety culture, in which every actor understands and integrates the objectives defined by safety regulations. It also reinforced its surveillance of sub-contracting and improved the management of non-conformance and deviation reports in conformity with the Basic Nuclear Installation (INB) Order.

In June, the ITER Organization created a Beryllium Management Committee to begin to establish the rules and best-practice guidelines for the safe handling of the armour material chosen for the plasma-facing components of the vacuum vessel well in advance of their arrival on site.

On 20 August 2015, during a visit to an industrial site in Sassenage, France, French President François Hollande signs an industrial component destined for ITER's liquid helium plant.

This cable-in-conduit conductor has been prepared in Japan for the ITER central solenoid, which is under fabrication in the US (next page). By end 2015, 40% of the required conductor had left Japanese production lines. Photo: ITER Japan.

Manufacturing

First machine components delivered

In the eight years since the ITER Organization signed its first Procurement Arrangement (November 2007), a total of 91.2 percent of allocated in-kind value has been committed through 106 Procurement Arrangements. After lengthy design and qualification phases, fabrication activities are now underway on all of the systems and components required for First Plasma. The ITER Organization estimates the level of design completion at 89 percent and the level of manufacturing completion at 24 percent (based on ITER Unit of Account value credits as of 31 December) for First Plasma components and systems.

A major manufacturing achievement was celebrated in December 2015 as 460 tonnes of cryostat base segments were delivered by India. The arrival of the segments represents a double milestone for the ITER Project – the arrival of the first machine components, and the ahead-of-schedule achievement of the first project milestone validated by the ITER Council in November for the years 2016-2017. Assembly and welding activities for the cryostat base will begin on-site in 2016, as the remainder of the cryostat base segments and the lower cylinder segments leave the production line in India.

The global campaign to procure superconductors for ITER's powerful magnet systems drew to a close after an eight-year effort that involved six of seven Members (China, Europe, Japan, Korea, Russia and the United States). Suppliers have completed 100 percent of niobium-tin (Nb_3Sn) superconducting strand for the toroidal field coils (500 tonnes) and 80 percent of the strand for the central solenoid (128 out of an expected 160 tonnes), plus 300 tonnes of niobium-titanium (NbTi) strand for the poloidal field coils, correction coils and busbars. Nearly all toroidal field conductor unit lengths and half of poloidal field conductor unit lengths are registered in the ITER Conductor Database.

Serial production is underway to produce the building blocks of the toroidal field coils and cases, the central solenoid and the correction coils. For the poloidal field coils and magnet feeder components (such as feedthroughs and high temperature superconducting current leads) qualification activities are progressing.

An improved management environment for the fabrication of the ITER vacuum vessel led to the re-start of manufacturing activities in Europe and the resolution of technical issues in Korea. Nearly all base material for the upper ports was procured by Russia, and the first batch of in-wall shielding components was produced in India. The four procuring Domestic Agencies are working in tight collaboration with the ITER Organization in the framework of the Vacuum Vessel (VV) Project Team to improve manufacturing performance for this critical and schedule-sensitive ITER component.

Following the success of mockup winding (pictured) at the central solenoid fabrication facility in the US, winding has begun on the first production module. Photo: US ITER

Cooling water system drain tanks and buried piping arrived on site during the year as well as five storage tanks for the Tritium Plant's water detritiation system. Fabrication is underway on elements of the vacuum, cryoplant, cooling water and coil power supply systems. In 2016, the first completed diagnostic system and the first liquid helium (LHe) plant are expected on site.

R&D

Preparing for industrial manufacturing

The ITER Project is strongly supported in all physics-related R&D by the International Tokamak Physics Activity (ITPA), a framework for internationally coordinated fusion research activities among the ITER Members. Research advanced during the year in the key areas of plasma-wall interactions, plasma stability and control, and confinement and modelling. To reinforce the analysis of ITER plasma conditions through the development and application of modelling tools, the Director-General initiated a Scientist Fellow Network in 2015. This network will be tightly coordinated with the ITPA to ensure that the modelling tools applied to ITER are validated against relevant experiments.

As a contribution to ITER diagnostics, the US is designing seven instruments plus four port plugs. This test stand for the low-field-side reflectometer diagnostic mimics an ITER-like waveguide route. Photo: US ITER

The qualification phase for ITER's internal components is progressing strongly, as design choices are progressively validated through the fabrication and testing of semi- and full-scale prototypes. Industrial suppliers successfully manufactured prototypes of tungsten divertor targets, the beryllium first wall of the blanket and a series of enhanced heat flux blanket "fingers," while mockups are underway for the divertor cassette bodies, the divertor dome, and the generic diagnostic first wall. Based on the results of R&D, the ITER Organization also moved closer in 2015 to a final decision on the front-surface shape of the divertor's tungsten monoblocks.

In support of the magnet feeder development program, high temperature superconducting (HTS) current lead prototypes were tested and the first cryostat feedthrough is ready for manufacturing. The development of in-vessel coils for vertical stability and Edge Localized Mode (ELM) control also progressed as analysis and the fabrication of long-length conductor prototypes showed that the modified design and reference conductor effectively address manufacturability and robustness issues.

The first components were installed in the Neutral Beam Test Facility in Italy, where the ITER Organization and the Domestic Agencies of Europe, Japan and India are collaborating to test the innovative technologies and unprecedented scale of ITER's heating neutral beam system. The components for the first testbed to enter into operation, the ITER-scale negative ion source SPIDER, are all in production.

Finance

The best management of Member contributions

By tracking the budget process carefully and conducting regular variance analysis, the ITER Organization effectively executed 90 percent of its commitments budget and 86 percent of its payments budget for the year. Resource estimates for the remainder of the construction phase were prepared for every ITER business unit in a bottom-up fashion, taking into consideration future procurements, hardware needs, external contracts and staffing. This exercise was an important part of the project-wide effort in 2015 to update the long-term schedule.

A Reserve Fund has been established under the control of the ITER Organization Director-General for the cost-effective funding of changes to the project Baseline that arise during the construction phase of the project. The timely financing of adjustments to the design has already proven to be an effective tool for avoiding significant slippages in the schedule as well as future cost overruns.

The experts of the Financial Audit Board, comprised of representatives from every ITER Member, issued an unqualified audit opinion on the previous year's annual accounts and recognized proactive initiatives taken by the Organization to improve accountability and transparency in financial management, contract administration and budgetary controls. A second review was conducted on the 2015 trial balance for the period of 1 January to 30 June, including an examination of expenditures and contract administration.

The final total of commitment appropriations for 2015 was EUR 247.3 million (including EUR 32.4 million in the Reserve Fund) to which EUR 11.0 million of de-commitment from previous years' contracts was added and against which commitments of EUR 204.5 million were made, leaving a balance of unused commitment appropriations of EUR 53.8 million to be carried forward to 2016. The payment appropriations for 2015 were EUR 277.7 million (including EUR 47.2 million in the Reserve Fund). Of this, EUR 197.1 million was paid, leaving a balance of unused payment appropriations of EUR 79.7 million (see Financial Tables).

Staffing

Managing human resources as a strategic asset

With 92 appointments and 42 departures over the course of 2015, 642 staff members are now directly employed by the ITER Organization (see Staffing Tables). In the context of organizational changes set into place by the Director-General, the ITER offices for project control and central integration were strengthened through recruitment, new units were created, and hundreds of job descriptions were re-aligned with assignments. The strategic consideration of longer-term needs resulted in a planning exercise to estimate staff and contractor engineering resources to the end of the phases of construction, assembly, installation and commissioning.

To intensify scientific and technological exchanges with the Domestic Agencies or Member fusion laboratories, a new staff category – ITER Project Associates – was created to allow experts to join the ITER Organization on assignment while remaining in the employ of home institutions. Five Monaco-ITER postdoctoral researchers, 20 visiting researchers, 29 student interns and 51 experts also worked for the ITER Organization during the year.

The ITER Staff Committee continued to represent staff interests in 2015 by consulting formally and informally with ITER management on rule and regulation changes, assisting staff with difficulties, and managing subcommittees on education, sports and culture. The Staff Committee also worked to bring issues relating to the Provence-Alpes-Côte d'Azur International School in Manosque, where 53 percent of the 672 students attending in 2015 were from ITER families, to the appropriate forums for discussion.

External Relations

Bringing ITER to the front of the scene

Since 2008, the ITER Organization has signed 44 Memoranda of Understanding for technical, scientific or academic cooperation – including agreements signed in 2015 with Keio University (Japan), Università degli studi di Palermo (Italy), the University of Liverpool (UK), the Institute of Plasma Physics of the ASCR/IPP-Prague (Czech Republic), and the University of Ljubljana (Slovenia).

The 2015 edition of the ITER Business Forum was organized in Marseille, France with the support of the European Domestic Agency Industrial Liaison Officer (ILO) network, Agence Iter France, the Marseille-Provence Chamber of Commerce and Industry, and local authorities. This international event, which attracted more than 860 participants, takes place annually to facilitate business and partnership opportunities between companies already involved in ITER procurement and other interested firms, and to inform the world of industry on upcoming opportunities at ITER.

The ITER Project continues to attract the interest of the general public. More than 100,000 people have visited the worksite since tours opened in 2007, including 17,000 in 2015. In addition to worksite visits offered in English and French throughout the year, Open Doors Days were held on two occasions. ITER also hosted a large number of press delegations, international delegations and high-level visitors, including the Chinese ambassador to France, two former French Ministers, the president of the Bouches-du-Rhône department, a congressional delegation from the United States, and the Chief Executive Officer of the United Kingdom Atomic Energy Authority.

Project progress was showcased at international events such as the Symposium on Fusion Engineering (SOFE), the International Conference on Magnet Technology (MT-24), and the ITER International School. ITER also presented an exhibit at the 21st Conference of the Parties on Climate Change (COP-21) in Paris, as part of the exposition dedicated to low-carbon solutions.

More than 100,000 people have visited the ITER worksite since tours opened in 2007, including 17,000 in 2015.

Delivery of ITER's largest and heaviest components takes place along the ITER Itinerary. But before travel by road there is a maritime segment . . . where the loads are transported by barge through a six-kilometre-long channel (pictured) and across the inland sea at Berre.

2015 HIGHLIGHTS
BY DEPARTMENT

Cabinet (CAB)

The Cabinet supports the Director-General in all matters related to the management of the ITER Organization and in his global responsibility as Chief Executive Officer and Chair of the cross-decisional Executive Project Board. CAB liaises with official bodies and partner government organizations and assists the Director-General in his external and international interactions. Through its Legal Affairs and Communication offices, CAB also provides legal advice to the Director-General and develops and executes a comprehensive internal and external communication strategy.

In 2015 the newly formed Cabinet assisted in the reorganization of the ITER Organization and in the implementation of other Action Plan measures following the appointment of Director-General Bigot by the ITER Council in March.

The Cabinet structured its work between the technical and administrative support of the Director-General and the Deputy Director-Generals; coordination with the Legal Affairs and Communication offices; interfacing with external stakeholders; document editing in support of the ITER Council and its advisory bodies; and the follow-up of internal decisions and interdepartmental projects. The Cabinet participates in a number of key committees such as procurement assessment and crisis management; ensures administrative support for the bi-monthly Central Team Management Board; and organizes the Unique ITER Team weeks that reunite ITER Organization and Domestic Agency staff at ITER Headquarters. It also acts as secretary to the Executive Project Board.

Communication (COM)

Communication worked in 2015 to drive changes introduced by the new Director-General and to elevate their public visibility and, in so doing, to transform ITER's internal work environment, external image, and working relationships with partners.

Through regular all-staff meetings as well as through written correspondence, the Communication Office supported the internal communication of the Director-General and worked to ensure that the strategic direction of the ITER Organization was well understood by all. Communication collaborated with ITER managers and staff as needed to ensure the healthy top-down and bottom-up flow of information relative to the project, to clarify questions and counter rumours, and to resolve professional and technical concerns. The Office also served as an internal communication resource for all staff and contractors to bring issues (ideas, suggestions, problems) as needed to ITER management attention. A number of staff events were organized during the year to enrich the work environment.

The ITER Organization public website (www.iter.org) was entirely revamped, modernized and re-introduced in November. Communication also managed the project's presence on social media (Facebook, Twitter, YouTube and LinkedIn), issued press releases on major ITER milestones, and maintained a large stock of photo and video resources and B-roll footage to document ITER progress in formats that are usable by the general public and the media. In addition to the *ITER Newsline* (published weekly since 2006) and the quarterly publication *ITER Mag*, Communication developed a photobook in collaboration with the ITER Domestic Agencies to showcase manufacturing and construction progress.

For poloidal field coil #6, which will be manufactured in China under an agreement concluded with Europe, tooling and component qualification is underway. (In the picture: a vacuum chamber for leak tests.)

In collaboration with Agence Iter France and the European Domestic Agency, the ITER Organization offered ITER site tours to more than 17,000 visitors including the general public, school and university groups, journalists, VIPs, ITER staff groups, and partners. Open Doors Days organized in June and October each attracted 800 visitors for a customized site tour by bus and a stop at the ITER Visitors Centre. Communication represented the ITER Project at the United Nations Climate Conference (COP-21) and at the FuseNet conference in Prague, and supported the Director-General and other ITER experts in ensuring a presence at relevant scientific and professional conferences. It also assisted in the organization of the annual ITER Robots contest for high school students and the local sporting competition, the ITER Games.

Finally, Communication takes the lead in cultivating communication points of contact in each Domestic Agency, working with partners in the fusion community and maintaining contacts with local and national government agencies, educational groups, and professional groups to promote ITER's image. In 2015, a Director-General Newsletter was introduced to periodically update stakeholder audiences on key points of ITER Project progress, including successful adherence to schedule milestones.

Legal Affairs (LGA)

Legal Affairs advises the Director-General and the departments as well as the governing bodies of the ITER Organization such as the ITER Council, the Management Advisory Committee and the Test Blanket Module Program Committee.

In 2015 Legal Affairs was involved in governance issues, contributing to the implementation of the Action Plan of the new Director-General, advising on issues of international labour law and the interpretation of ITER constitutive agreements, and supporting the Test Blanket Module (TBM) program and the ITER Beryllium Management Committee. In parallel, it continued to manage the nuclear liability issues with the Members and ongoing negotiations with the Nuclear Energy Agency concerning the inclusion of ITER in the Paris Convention.

In order to secure ITER Organization activities, Legal Affairs was responsible for drafting 9 agreements, 11 license agreements and 16 Memoranda of Understanding. Legal Affairs accompanied ITER construction by leading negotiations on the necessary notarial deeds and site agreements and providing support in relation to administrative authorizations such as building permits. Legal Affairs provided advice on the French laws and regulations to be observed by the ITER Organization in application of Article 14 of the ITER Agreement and interfaced with French authorities on these issues, in particular concerning working conditions on the construction site.

Following a six-month exercise to assess the design maturity, manufacturing schedules, and assembly sequences of each machine and plant component, the ITER Organization and Domestic Agencies presented an updated schedule to the ITER Council in November.

The legal team contributed to the protection of ITER Organization interests by providing advice on the implementation of privileges and immunities, on visa issues and work permits for contractors, and on the increasing number of value added tax (VAT) exemption and customs issues related to the arrival of the components or their transportation between Members. A specific webpage on legal resources was put in place on the public website to provide legal information and informative links on the specificities of ITER.

In order to raise staff awareness of the ITER Organization legal framework, Legal Affairs conducted trainings on the framework, on the specific status of international civil servants, and on intellectual property.

Legal Affairs continued to manage intellectual property (IP) related issues. Legal Affairs coordinated the implementation of the IP legal framework within the ITER Organization through the IP Board and advised on IP issues – including publications, contracts, Procurement Arrangements, non-disclosure agreements, and communication – to line management and technical responsible officers. The seventh Intellectual Property Contact Persons meeting took place in the ITER Organization in September.

In May the first plant component – an electrical transformer – is installed in its permanent position on site.

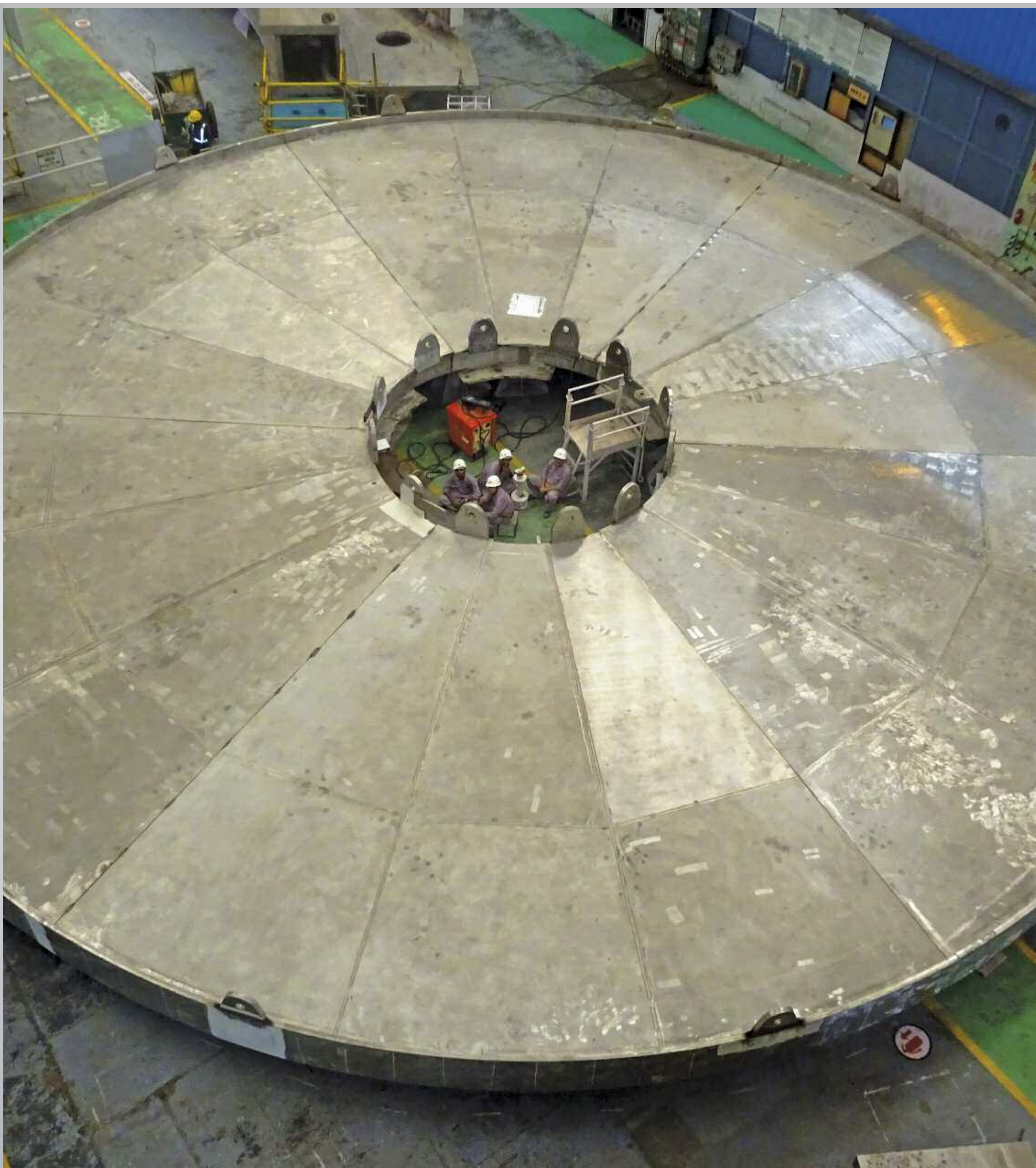
Internal Audit (IAS)

The work of the Internal Audit Service is aligned to the business goals and objectives of the ITER Organization and audits are conducted according to a comprehensive risk-based plan that is updated periodically. In 2015, IAS audited the accounting of liabilities and provisions for the 2015 ITER Organization Financial Statements. Other important topics of audit included the approval process of technical documents, the use of experts and contractors, the CAD engineering support process, SmartPlant® software, the export control process, and contract administration.

IAS also performed advisory services as requested periodically by management and carried out important assignments related to mission travel, leave salary and the removal process on separations. Similarly, in conjunction with ORAP, IAS carried out an exercise to simplify 20 important Management and Quality Program (MQP) procedures and other processes during the year with the aim of reducing bureaucracy as recommended by the 2013 Management Assessment.

To further streamline the process of contract administration and invoice payments, a test check was performed for some high value payments and timely reports were presented to division and department heads in order to facilitate corrections and rectifications. IAS also followed up on the implementation status of its recommendations, of which a large number were addressed and implemented during the reporting period by line management. Finally, at the end of the year IAS carried out an annual risk assessment exercise that culminated in a three-year rolling audit plan for the Organization.

On the shop floor in India, Tier 1 of the ITER cryostat base is assembled to verify tolerances before being shipped to ITER. Photo: ITER India



ITER Council Secretariat (ICS)

The ITER Council Secretariat supports the activities of the ITER Council and its subsidiary bodies such as the Management Advisory Committee (MAC) and the Council Preparatory Working Group (CPWG) in accordance with the Rules of Procedure of the ITER Council. In 2015, the ITER Council met for an Extraordinary Meeting in March, for its Sixteenth Meeting in June and its Seventeenth Meeting in November. The Management Advisory Committee met twice: in May (MAC-19) and in October (MAC-20). ICS also supported the Financial Audit Board in relation to its 2015 financial audit activities.

External Relations & Action Plan Implementation Office (ORAP)

The ORAP Office provides support to the Director-General in all matters related to cooperation and coordination with the Members and their relevant domestic institutions, as well in the simplification of Management and Quality Program procedures as foreseen in the Director-General's Action Plan.

In 2015, the External Relations & Action Plan Implementation Office worked in close collaboration with ITER Members to organize the Director-General's visits abroad, to arrange meetings with senior government officials and parliament members, and to prepare presentations for his attendance at international conferences such as the International Symposium on Fusion Nuclear Technology (ISFNT) in Korea, the Falling Wall Conference in Germany, and the 17th International Conference on Fusion Reactor Materials in Germany. The ORAP also facilitated the visit of 11 high-level Member delegations to the ITER Organization.

In close cooperation with the Welcome Office of Agence Iter France, ORAP ensured prompt and efficient visa services to all ITER staff members and fielded questions and requests from ITER Organization and Domestic Agency staff on visa and work permit issues. It oversaw the management of framework contracts for visa issues and worked continually to improve services in the interest of efficiency. The Office also liaised with a provider of work permit services to facilitate administrative formalities for Domestic Agency contractors.

Following the appointment of the new Director-General, the ORAP worked closely with Internal Audit (IAS) and ITER Organization process owners to simplify and optimize 20 Management & Quality Program procedures and Internal Administrative Circulars. The Office promoted the balanced representation of all Members within the Staff Committee and supported the Domestic Agencies in the recruitment of highly qualified candidates for ITER Organization positions.

Quality Assurance & Assessment Division (QAA)

Quality Assurance & Assessment was created as an independent division in 2015, reporting directly to the Director-General. Its objectives are to specify project quality requirements, perform independent assessments on compliance with these requirements, and coordinate the integrated management system through the Management and Quality Program. The Division ensures that the processes needed for the quality management system are established, implemented and maintained; reports to top management on the performance of the quality management system; and works to promote awareness of ITER Organization or stakeholder requirements through the organization.

In 2015 Quality Assurance & Assessment continued to develop a central platform for collecting information on deviations and non-conformities; based on this tool, regular reports on the management of these issues could be made to the Central Team Management Board. Real progress was accomplished in 2015 on the resolution of longstanding non-conformities and a new system for tracking corrective actions is now in place.

The ITER Management and Quality Program (MQP) centralizes all management and quality requirements for executing the ITER Project. To ensure the application of MQP procedures throughout the project, a comprehensive review of MQP documents was undertaken by a working group during the year to verify completeness, coherence, comprehension and applicability. The working group met monthly with representatives from all ITER units.

The Safety and Quality Assurance Working Group (SQAWG) held two meetings to update Domestic Agencies on discussions held with the French licensing authority on safety, quality and licensing issues, especially with regard to Procurement Arrangements, manufacturing and component assembly. The SQAWG remains the principal forum for communication and discussion on safety and quality issues between the ITER Organization and the Domestic Agencies.

During 2015, the Division verified the effective implementation of the ITER Organization quality assurance program through 13 audits – seven at the Domestic Agencies and six at ITER. Audits focus on identifying risks, checking whether nonconformity management procedures meet ITER Organization and procedural requirements, verifying that the requirements of Task Agreements and Procurement Arrangements are met, and finally analyzing the communication between the ITER Organization and the Domestic Agencies.

The QAA Division was also active in providing support and advice for the creation of ITER Project Teams and the development of related documents.

Project Control Office (PCO)

The Project Control Office ensures the coordinated action of project controls, manages the ITER Baseline (scope, schedule, cost, and risk), monitors schedule delay and recovery actions, performs risk analysis, and evaluates and improves the efficiency of management systems.

The monitoring and control of the ITER Baseline – including the scope, schedule and cost of work – is a key project management function that was reinforced in 2015 through the reorganization of the Project Control Office. PCO focuses on monitoring project performance through industry-standard performance metrics and tools, controlling the schedule by tracking and acting on issues and strengthening the project approach to risk management.

Work on the establishment of an updated, resource-loaded project schedule accelerated under the new Director-General, who mandated an in-depth, bottom-up review and analysis of all aspects of construction, manufacturing, assembly and commissioning of the ITER components and systems.

The Project Control Office integrated Detailed Work Schedules (DWS) received from the Domestic Agencies based on the latest supplier information with detailed technical schedules from the ITER Organization to create a fully integrated, fastest technically achievable path to First Plasma and deuterium-tritium operation, encompassing all engineering, procurement, construction and operational activities. In parallel, draft resource estimates for the ITER Organization were completed for the construction phase on an "estimate to completion" basis.

The method and assumptions underpinning the draft updated long-term schedule were the object of two intensive reviews – an internal technical review in August as well as a project-wide review in September attended by management from the ITER Organization and Domestic Agencies as well as the Chair of the ITER Council.

As a result the best technically achievable schedule was endorsed by the ITER Organization and Domestic Agency stakeholders for presentation to the Management Advisory Committee in October and the ITER Council in November (IC-17). The Seventeenth Meeting of the ITER Council acknowledged the much-improved understanding of the scope, sequencing, risks, and costs of the ITER Project and commended all contributors on the schedule exercise. In 2016, the updated long-term schedule and associated budget and staffing resources will be the object of an independent review mandated by the Council.

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Until the ITER Project has an approved long-term schedule, project progress will be controlled and reported on the basis of 29 "high-level" milestones that were approved for the years 2016 and 2017 by the ITER Council. Performance against these milestones will be reported to the Council every two months.

In 2015, the ITER Organization adopted a more systematic approach to issue and risk management. Risks and issues are now monitored and tracked; risk owners are identified and – where the issues are large and complex – specific Project Teams are formed. A dedicated team has been identified in PCO to work with technical responsible officers on a monthly basis; this team will aim to improve the opportunity and risk management capabilities within the ITER Organization by carrying out probability and impact assessment and suggesting appropriate risk mitigation measures.

Improvements were also made to project management tools and procedures. As part of plans to implement Earned Value Management (EVM) as a methodology to track project progress against baseline schedule and cost, the Project Control Office has an EVM pilot up and running and will roll it out to the full project in 2017. The development of Key Performance Indicators is also underway and new IT systems have been introduced for performance monitoring, risk management, and scope management.

The Project Control Office is preparing the Project Management Plan by identifying processes and procedures and organizing hierarchical and communication channels. The draft proposal will be ready for review in 2016.

Central Integration Office (CIO)

The Central Integration Office is responsible for design control and integration; systems engineering; engineering quality control; configuration management; the development and maintenance of information tools (IT); Computer-Aided Design (CAD) resource management and design activities; systems analysis and standards; and documentation and records.

As part of the move to strengthen key transverse project functions, a strong Central Integration Office was reintroduced in 2015 to freeze the design of critical components, establish design integration and control, and implement robust systems engineering and configuration management for ITER.

Supported by a group of CAD core team designers, the Design Integration Section/Division maintains the technical baseline documents, manages design changes affecting overall configuration, and ensures that integrated systems function as intended through functional analysis. The analysis of deviation and project change requests this year resulted in changes to approximately 40 3D configuration models – out of the set of 1,000 that define the overall layout of the tokamak and plant systems – in order to maintain the consistency between the detailed design of components and the baseline. Design Integration reviewed mechanical interfaces, accessibility, and space allotments throughout the machine and made a substantial contribution to the identification of critical tolerance areas. A database of Tokamak gaps will be completed for the full machine in 2016.

An early assessment of critical gap issues and their potential impact on tooling and assembly processes was performed for magnets, the cryostat, the vacuum vessel and in-vessel components. The Division ran dimensional variation studies on critical areas using a model that has been benchmarked and qualified (the 3DCS Tokamak Variation Model) and supported the Domestic Agencies with specific variation analyses related to manufacturing. A handling process for the vacuum vessel port plugs was developed and successfully tested on a 10-tonne prototype equatorial port plug, allowing the handling features to be implemented into the port and port plug models. Specific design integration reviews focused on tokamak assembly sequences including component integration and compatibility with assembly tooling.

Building designs progressed under the oversight of Tokamak Complex and auxiliary building area managers. Design Integration reviewed all configuration control models related to Tokamak Complex buildings and delivered the final product to the European Domestic Agency. The configuration layout for systems and building services was completed for levels B1 through L2; changes in the design of the tokamak cooling water system were implemented in level L3 models (Tokamak and Tritium buildings); and activities commenced on the L4 integration cycle.

A field task force was formed with members of the Buildings, Infrastructure & Power Supplies (BIPS) Project Team to review the impact of changes to building layouts caused by constructability issues prior to concrete pouring. This field task force reports to systems owners about any deviation from baseline.

By the end of the year systems integration reached the final design maturity stage for all auxiliary buildings required for First Plasma. Cooling tower integration was delayed due to changes in the cooling water system design; however, a successful Manufacturing Readiness Review held for the first part of civil structures enables construction to begin as planned in 2016.

The Design Integration Section/Division issued a design plan for transverse activities such as piping, the design of penetrations, embedded plates, and platforms. Its Systems Engineering Section advanced the functional integration of ITER systems and worked with other business units to promulgate a common systems engineering culture. The Section undertook to simplify the allocation and classification of requirements and systematically reviewed all process flow and piping and instrumentation diagrams to verify system maturity; in the longer term, this groundwork will coalesce into a complete picture of the design/manufacturing phase of the systems and the maturity of systems designs. The Section is planning specific simulations to validate systems integration (for example between the magnet and vacuum systems) and to prepare for integrated commissioning.

Following the validation of a full-scale prototype segment (pictured), fabrication is now underway in Korea on all nine 40° vacuum vessel thermal shield sectors. Photo: ITER Korea

The configuration management process was re-organized to streamline decision making and to reinforce the joint control authority of the ITER Organization and the Domestic Agencies over changes to the baseline. All decisions on design changes affecting the scope, schedule or cost of the project are now made at the Level II Configuration Control Board (CCB), which is in charge of project change requests and also acts as a technical coordination meeting for the resolution of any technical issues escalated from department level (Level III). Final endorsement for any changes requiring the Reserve Fund is made at the level of the Executive Project Board (Level I).

The Configuration Management Section/Division worked with the Project Control Office and IT on a tool that centralizes all technical issues and permits the tracking of follow-up actions. Issue resolution status was regularly reported by Level II-CCB to the Executive Project Board. Other accomplishments during the year include support for preparing, monitoring, and reviewing design plans for all systems and controlling technical deliverables as well as propagating safety and technical requirements to the individual system requirements documents (work to be completed in 2016). A document

The completed steel structure of the ITER Assembly Building, now the tallest structure on the ITER platform.

management task force, which includes representatives of the ITER Organization technical departments and the Domestic Agencies, was established under the Document Control Section to streamline and integrate existing processes related to document management and control.

In July 2015, the Executive Project Board confirmed the selection of ENOVIA V6 as the product life management (PLM) tool that will unify supporting information systems into a single platform. A team has been formed within CIO to oversee the adaptation and implementation of this tool, which is critical to the enforcement of standardized systems engineering and configuration management processes and procedures.

The Project Information System Section/Division (IT) manages computer systems and related services, databases, network infrastructure, telecommunications and the ITER internal and external websites. In 2015, IT supported more than 1,700 users, handling 20,000 user tickets, hosting 4,000 video conferences, and monitoring the performance of essential services (telephone, e-mail, printers, servers) to ensure high availability. Cyber security was reinforced for both in-house and external users.

Work on the huge steel frame of the Assembly Building ended in September as the 730-tonne roof structure was lifted and secured into place.

Beyond daily user support, IT is active in customizing information applications in the areas of engineering, project management and administration to the project's evolving needs. In 2015 the group made adjustments to ITER's principal administration tool, SAP, to reflect organizational changes; created new financial processes and reports; implemented improvements to the Procurement Arrangement database; supported the integration of the new plant design suite from AVEVA; and completed most of the adaptation and integration of the SmartPlant® software suite. As component deliveries are intensifying, IT created a delivery portal that allows users along the full delivery chain to upload data to ITER's materials management tool (SmartPlant® Materials), effectively creating one location for all delivery-related data. IT was also involved in the early implementation studies of the new PLM tool and worked with the Project Control Office on improvements to schedule integration. In addition, after two years of collaboration with Communication, IT successfully launched an all-new ITER Organization public website in November.

The Design Office Division administers the project's computer-aided design (CAD) infrastructure, organizing the deployment and availability of the CAD platform and data and supporting approximately 650 users at the ITER Organization, the Domestic Agencies, and suppliers. It maintains the context branch to provide the most valid interface data to concurrent users and encourages standardization through the production of CAD catalogues.

The Office supports its clients – mainly technical officers responsible for the components and systems of ITER – in developing diagrams, models, standard parts and drawings. It also oversees the activities of the 54-person CAD core team established last year as well as that of the outsourced work packages. In 2015, in close collaboration with all department CAD coordinators, the Division prioritized tasks according to project milestones in order to ensure maximum efficiency against the schedule. CAD infrastructure was enhanced to offer efficient geographical filtering and the possibility of producing manufacturing/construction phase deliverables, in particular in the plant design area. User support continues through on-line workshops and weekly calls to the design offices at each Domestic Agency.

As the construction of the Tokamak Complex progressed, the Analysis Section/Division was instrumental in responding to Requests for Information related to building design, and in defining the interface loads between buildings and equipment that are critical to determining the final size and location of the thousands of embedded plates used to anchor equipment. Structural and nuclear analyses performed by the Section also contributed to solutions for the electronic shielding and Tokamak Cooling Water System radiological issues and to a revision of the analysis methodology for the sector sub-assembly tool. Thirty-three additional System Load Specification reports were prepared in 2015, bringing the completed list to 201.

In the area of seismic analysis, the Section evaluated the impact of design changes in the Tokamak Building on the machine and was able to confirm the reliability of the previous evaluation. New intermediate seismic floor response spectra were provided for seismic events rated SL-2 and the methodology of SL-3 evaluation is ready; through collaboration with the European Domestic Agency work has started on the floor response spectra for all auxiliary buildings. Load evaluations were completed for the anti-seismic bearings of the Tokamak Complex, and the impact of building changes on the stress in the lower basement (B2) slab was assessed for SL-2 and SL-3 events.

The Section refined the nuclear analysis of the vacuum vessel and the toroidal field coils to reduce uncertainties,

Regular columns in place at the B2-level of the Diagnostics Building will support the next level of construction. Work is also underway on the internal and external walls. Photo: F4E

analyzed the new generic design of the bioshield plugs to propose solutions, and completed extensive radiation transport simulations for the neutral beam cell that resulted in the release of a French Nuclear Regulator (ASN) hold point. The Section continued to support the Domestic Agencies in the use of the global nuclear model of the Tokamak (C-lite) and made progress in discussions on ITER's policy for electronics exposed to radiation through formal reviews of each system. A new working group was established on electronics radiation conditions to identify all affected electronics and to propose countermeasures.

Electromagnetic (EM) field maps (values and derivatives) continue to evolve and a full inductance (flux linkage) matrix has been evaluated for the ITER magnet system in order to form the basis for the reconstruction of EM scenarios and direct simulations. The analysis of EM loads on systems progressed and the ITER Organization now has a tool for the evaluation of EM shielding for equipment. For the in-vessel components, the global model for EM analysis was updated and distributed to the Domestic Agencies and parametric models were used to evaluate the blanket loads for all plasma transient events. The Analysis Section routinely provided reports on material properties and radiation effects in support of material procurement and reviewed manufacturing reports, material inspection procedures and material test certificates in collaboration with the Domestic Agencies.

Safety Department (SD)

The Safety Department supports the Director-General in all matters related to environmental protection, nuclear safety, licensing, occupational health and safety, and safety and security. It ensures that safety and security standards are implemented and enforced throughout the ITER Project with all concerned stakeholders in compliance with Host country's safety and security regulations.

The Safety Department maintained independent surveillance in 2015 as established in French regulations for Basic Nuclear Installations (INB), acting as the interface between the ITER Organization and local, national and international government agencies with respect to safety and security standards. Technical exchanges continued with the French Nuclear Regulator ASN on prescriptions related to the ITER stress test – a postulation of extreme climactic events that has demonstrated the adequacy of the ITER safety margins even in the face of the most improbable circumstances.

In 2015 ASN performed inspections on the fabrication of the vacuum vessel in Korea, and on the manufacturing, transportation and storage of the tokamak cooling water drain tanks delivered by the US; it also controlled ongoing civil works on three occasions. In-situ inspections of this type will be pursued, and even accelerated, in the years to come as the manufacturing/construction of safety-related components/facilities progresses. The French regulator also closely monitored newly introduced organizational changes in order to assess the reliability and compliance of the new organization.

Strong emphasis was placed on the timely and effective resolution of discrepancies such as non-conformance and deviation reports; as a result, the backlog of these reports has been significantly reduced. The Organization also reinforced its surveillance of sub-contracting in conformity with the INB order and in the context of the creation of Project Teams. In response to an ITER Organization petition, notification during the year confirmed that all port plugs and some parts of diagnostic systems fall outside of French regulations (ESPN) on pressure equipment.

Efforts to instill a project-wide safety culture continue. Safety workshops were organized to address not only applicable regulations, but also the philosophy of how safety should be approached across the entire scope of the project. A seminar was also proposed to technical responsible officers in order to emphasize the importance of non-conformity management, which is a regulatory requirement for safety-important components. Members of the Safety Department continue to attend the public meetings of the Local Information Commission (CLI). In 2015 a public meeting was held on the economic benefits of the project, site working conditions and manpower projections.

The Security, Health & Safety Division is responsible for the protection of people and property, the protection of nuclear materials, the protection of data, and the health and safety of workers. In 2015 the database on occupational hazards was equipped with a new portal, whose objective is to communicate on roles and responsibilities; to provide standardized information on hazards, failure modes, potential consequences and mitigation measures; and to facilitate access to occupational health and safety requirement documents for the design of ITER facilities.

Prevention remains the crux of the team's activities. In 2015, 224 staff were trained to use fire extinguishers, over one hundred evacuation guides followed a training or refreshment course and four building evacuations were performed, and more than 70 fire permits were managed. A unique security badge was introduced during the year which offers a higher level of security. Specific occupational safety and security procedures and processes were also put in place to cover storage areas 1 and 2.

ITER's new Beryllium Management Committee will establish the rules and best practice guidelines for the safe handling of the armour material chosen for plasma-facing components.

Tokamak Engineering Department (TED)

The Tokamak Engineering Department is in charge of the design, procurement, acceptance, installation, commissioning and operation of the core tokamak systems. These include the blanket, divertor, vacuum vessel, cryostat, thermal shields, magnet system, in-vessel coils, port plugs and diagnostic systems, heating and current drive systems, and the Test Blanket Module program. TED scope also covers system instrumentation.

Manufacturing activities for the ITER tungsten divertor progressed in 2015 through a number of significant qualification milestones. Following the approval of pre-production documentation in Europe, fabrication began on three full-scale divertor cassette body prototypes; contractors completed the manufacturing design of the divertor dome and began on a prototype in Russia; and Europe and Japan both successfully produced full-scale, full-tungsten plasma-facing units in conformance with the tight tolerances and the stringent acceptance criteria of the ITER Organization. Four of the outer target units manufactured by Japanese industry performed well under high heat flux tests at the Divertor Test Facility in Russia, demonstrating excellent tungsten-copper alloy bonds and material behaviour.

Ongoing R&D tasks for operational instrumentation produced results as optical fibre acoustic sensors were successfully fabricated and tested and promising techniques for optical fibre feedthrough prototypes emerged. The design of the divertor rails was updated during the reporting period to absorb the increased tolerances of the vacuum vessel and the last element of divertor cassette remote handling was demonstrated at the Divertor Test Platform in Finland.

After a broad integrated effort to update blanket system interfaces a revised configuration management model of internal components was released that takes recently approved design changes into account, such as an increase in blanket dimensions to improve neutron shielding. The detailed models of affected shield blocks were produced and transmitted to the procuring Domestic Agencies through the Blanket Integrated Product Team.

The ITER Organization created a Beryllium Management Committee in June to establish the rules and best practice guidelines for the safe handling of the armour material chosen for the plasma-facing components of the vacuum vessel. Following the Committee's first meeting in September work advanced quickly to identify the regulatory framework, set up the underlying management documents, and plan for staff training. Successful qualification activities for the beryllium first wall were achieved in Russia, where a semi-prototype was realized; in China, where enhanced heat flux fingers were produced and manufacturing equipment commissioned; and in Europe, where a beryllium-copper bonding technique was selected for the procurement of blanket first wall panels. The European Domestic Agency held production readiness reviews with the suppliers of three full-scale prototypes in advance of the planned signature of the Blanket First Wall Procurement Arrangement. The shield block qualification phase was successfully completed in China and Korea.

In December, a final design review was held for the complex array of piping that will feed cooling water to the blanket modules – the blanket manifold system. As part of the procurement of blanket connections, Russia launched a test program to verify the robustness of various ceramic coatings for the key pad interfaces between the blanket shield blocks and the walls of the vacuum vessel. Work has also accelerated on the design of a set of structures that will be temporarily installed inside the vacuum vessel in the absence of the blanket and divertor for First Plasma operation – First Plasma protection components – after a Project Change Request on this issue was accepted for implementation.

With the signature in March of the sixth and final Test Blanket Module (TBM) Arrangement with India, the working framework that governs the TBM program up

The fabrication of the ITER vacuum vessel is underway in Europe (seven sectors), India (in-wall shielding), Korea (two sectors plus equatorial and lower ports), and Russia (upper ports). In this photo, machining is underway on a steel component for one of the European sectors. Photo: F4E

to delivery and site acceptance tests is now complete. Conceptual design reviews were held for Japan's water-cooled ceramic breeder, Korea's helium-cooled ceramic reflector, and Europe's helium-cooled lithium-lead and helium-cooled pebble bed systems, as well as for associated ITER Organization activities such as common maintenance tools and port cell components. All observations from the 2014 review of China's test blanket system were resolved and the conceptual design was fully approved in 2015. Significant R&D activities were also reported from the US and Russia in support of the TBM program.

In an important step towards managing intellectual property related to test blanket systems, the ITER Organization submitted a preliminary proposal for the handling of restricted-access documentation and data from the ITER Members. The ITER Organization also signed Memoranda of Understanding with the TBM Leaders – China, Europe, India, Japan and Korea – to officially establish the transfer of responsibility to the ITER Organization for the design and procurement of test blanket system connection pipes. In November, an agreement was reached with the French Alternative Energies and Atomic Energy Commission (CEA) that makes virtual reality tools and CEA nuclear safety expertise available for the design integration of components under ITER Organization scope.

A Test Blanket System task force was created in 2015 to address a French Nuclear Safety Authority (ASN) request to demonstrate that the general ITER safety case envelops the safety case of the test blanket systems. Work is also underway to develop a strategy to implement European regulations on nuclear pressure vessels (ESP/ESPN) in the TBM designs. Within the framework of the working group on radwaste management, preparations continue for the signature of a trilateral agreement between the ITER Organization, the TBM Leaders and the Host country. The French agency for the management of radioactive waste (ANDRA) completed its preliminary report on the acceptance of test blanket system radwaste in its repositories, noting no obstacles.

Within the Vacuum Vessel (VV) Project Team, formed in 2015 as part of the Director-General's plan to strengthen action and decision-making in critical areas, representatives from the Domestic Agencies charged with vacuum vessel procurement and members of the ITER Organization work in tight coordination to improve manufacturing performance. The team's early successes include a marked acceleration in document review and approval time, the establishment of a baseline schedule for all procuring Domestic Agencies for monitoring purposes, and the much-improved resolution of interface issues.

The technically challenging fabrication of the ITER vacuum vessel progressed in both Korea and Europe in 2015. The material for all plates and forgings was procured for the two vacuum sectors under Korean procurement responsibility, manufacturing drawings were finalized, and fabrication is underway on sector segments and lower port stub extensions. During a visit to the manufacturing facility in April, the French regulator ASN was able to confirm the effective management of external contractors and compliance with regulatory provisions.

The technically challenging fabrication of the ITER vacuum vessel progressed in both Korea and Europe in 2015.

In Europe manufacturing activities restarted in 2015 on sector #5 – including cutting, hot forming, machining and the first welding activities – and a solution was found for steel plate procurement following a major non-conformity with the original supplier. The manufacturing designs for all components progressed, including design approval for the sector #3 equatorial segment and heating neutral beam penetrations. Nearly all base material for the upper ports has been procured in Russia and the inner shell of the double-wall section of port stub extension #12 was successfully produced by the contractor. Test facilities for equatorial and upper port plugs are planned to carry out thermocycling, leak testing and pressure tests prior to installation on the vacuum vessel. Other achievements during the year include the final design review for the vacuum vessel port sealing flange and the development of a portable tool for leak testing.

The resolution of in-wall shielding manufacturing issues in India led to the successful conclusion of factory and site acceptance tests for the first batch of components and their subsequent shipment to the sector manufacturer in Korea. Following the validation of a full-scale prototype of a 10° vacuum vessel thermal shield segment, fabrication is now underway in Korea on all nine 40° thermal shield sectors.

The arrival of 460 tonnes of steel segments for the cryostat base in December was celebrated as a major project milestone, as these are the first completed machine components to reach and be stored at the ITER site. The delivery also represents the ahead-of-schedule achievement of the first project milestone validated by the ITER Council for 2016-2017. Assembly activities are scheduled to begin in 2016 in the on-site Cryostat Workshop.

Manufacturing activities continue strongly in India, where the remaining segments of the cryostat base, the lower cylinder and the assembly support frames will be ready for shipment during the first half of 2016. Technical documentation for torus cryopump housing was completed, and the final design of the rectangular bellows approved during a successful review, moving these cryostat sub-systems one step closer to procurement. Following the final design review of the vacuum vessel pressure suppression system (VVPSS), a task force was formed to address remaining issues relating to the strategy for water treatment in accidental situations.

In September, a final Conductor Meeting was held at ITER Headquarters to celebrate the near close of an eight-year international campaign to produce high-tech superconductors for ITER's magnet system. All of the procuring Domestic Agencies – China, Europe, Japan, Korea, Russia, and the United States – were present, as well as representatives of the applied superconductor community. The unprecedented scale of procurement activities, the successful international collaboration on design attributes, product standards, quality assurance measures and testing protocols, and the campaign's demonstrated success were recognized during the unveiling of a commemorative plaque that acknowledges all participating parties and suppliers.

With over 92 percent of toroidal field unit lengths now registered in the Conductor Database, industrial focus has turned to toroidal field coil fabrication.

With over 92 percent of toroidal field conductor unit lengths now registered in the ITER Conductor Database, industrial focus has turned to coil fabrication. Europe successfully completed tests on the first full-size, superconducting prototype of a toroidal field coil double pancake, 40 double pancakes were produced at the European winding facility in Italy (of which 80 percent were heat treated and transferred inside of a radial plate), and the stacking of pancakes for the first seven-layer winding pack has begun. Toroidal field coil activities under Japanese scope also advanced – double pancake series manufacturing is underway, coil structure sub-sections are in fabrication, and the first inner case section was successfully completed. More than 4,500 tonnes of high-strength ITER-grade steel will be required to produce the 19 massive encasements for the toroidal field coils.

In the on-site Poloidal Field Coils Winding Facility, European contractors installed the winding table and equipment corresponding to the fabrication of coils #5 and #2 in preparation for the first qualification activities to begin in 2016. Europe has awarded five of the six contracts that cover the full scope of activities, including winding tooling (2014), site and infrastructure (2014), impregnation and additional tooling (2015), manufacturing and cold testing (2015) and engineering integration (2013).

As part of pre-manufacturing activities for the fabrication of poloidal field coil #1, Russia successfully produced and tested several qualification samples (helium inlet, dummy conductor mockup, turn insulation) and commissioned the winding line with the fabrication of the first dummy double pancake. For poloidal field coil #6, which will be manufactured in China under an agreement concluded with Europe, tooling and component qualification is underway. Eight conductor unit lengths have already been delivered by Europe and Russia, together with two copper dummy conductors.

The first module for ITER's central solenoid is in production in the US following the successful installation of 11 tooling stations. Fabrication also started on elements of the structural support system, including the first lower key blocks and three prototype tie plates, and a cold testing facility was built for the final testing of each module at 4 K. The US closed out the final design review on assembly tooling and awarded contracts for the initial set of tools. Japan, which is producing the central solenoid conductor, had completed 35 percent of unit lengths by the end of the year. Magnet specialists from both procuring parties collaborated to test the performance of the conductor through an "insert coil test" in Naka. The conductor performed as predicted with no degradation.

R&D was pursued on the modified design and reference conductor for the in-vessel coils, with analysis demonstrating a significant reduction in fatigue and increased manufacturability, robustness and reliability. Development continues on a new bracket concept and on bending and welding mockups. The feasibility of long-length conductors was demonstrated through the manufacture of two 40-metre prototypes.

The fabrication of ITER's correction coils progresses in China, where the first pancakes were wound for the bottom coils, several key manufacturing steps were qualified, and the raw material for the coil cases was hot-rolled and extruded in prototype trials. The first manufacturing readiness assessment for a magnet feeder component was successfully held for a cryostat feedthrough (poloidal field coil #4), bringing five years of work to design and qualify this key feeder component to a successful close. High temperature superconducting (HTS) current lead prototypes were also successfully tested at 10 kA (correction coil type) and 68 kA (toroidal field type). Within the framework

In Russia, the last production length of toroidal field conductor is jacketed and compacted in June. The year 2015 marked the near close of an eight-year procurement campaign, with more than 90% of toroidal field conductor unit lengths produced in the factories of China, Europe, Japan, Korea, Russia and the United States. Photo: ITER Russia

of the magnet instrumentation contract signed in 2014 with the French Alternative Energies and Atomic Energy Commission (CEA), contracts were placed for the supply of cryogenic-temperature sensors and components for the measurement of helium flow. The first prototype high-voltage feedthroughs for magnet instrumentation cables were received for testing.

Approximately one hundred projects are underway for the design and development of ITER's diagnostic systems. Through annual coordination meetings involving all seven Domestic Agencies, the Port Plug & Diagnostics Integration Division encourages synergies, promotes problem solving, and seeks to resolve common concerns such as the integration of diagnostic systems, safety requirements, and instrumentation and control.

Nearly all diagnostics have reached either the intermediate or the final design phase and the first system – continuous external Rogowski (CER) coils – is expected to be completed in 2016. A Complementary Diagnostic Procurement Arrangement was signed during the year with Russia for the integration of upper port 7, conceptual design reviews were held for several systems in charge of monitoring dust, tritium and erosion/deposition in the tokamak, and preliminary reviews were held for diagnostic windows and in-vessel magnetic sensors. In March, elements of the micro-fission chamber became the first completed diagnostic components.

With over 100 plasma parameters relying on optical diagnostic systems, a reliable mirror surface recovery system is essential. R&D continues to suggest that radio frequency discharges are the most promising technique for the cleaning of diagnostic first mirrors. Five repetitive mirror cleaning cycles were achieved without noticeable degradation in Europe, Russia simulated radio frequency discharges, and the US plans a real-geometry first mirror mockup. A life-size mirror cleaning mockup has also been installed in the EAST tokamak in China.

Manufacturing was launched in 2015 for the mockup of the diagnostic first wall based on the generic design; in parallel the port-specific final design phase is underway. The interfaces with blanket shield cut-outs and the first-wall panel interfaces for distributed diagnostic systems were clarified and significant progress was achieved in the vacuum vessel weld interface and designs for the in-vessel diagnostic attachments, including acceptance by the Agreed Notified Body (ANB) of a strategy for qualification. Progress on many technical issues common to diagnostics advanced through R&D activities.

Engineering activities for the integration of diagnostic systems into the port plugs are shared by the Domestic Agencies and the ITER Organization. Work progressed strongly in 2015, with a focus on simplifying the design and optimizing performance. Following the adoption of a common approach to the manufacture of ITER's 22 port plug structures, the technical specifications were finalized and the call for tender launched. Design, resource and budget plans were also established for port plug test facility activities in 2015. Four test stands (two at the ITER Organization, one in Europe and one in the US) will enable the testing of upper and equatorial port plugs before their installation in the machine. The development of an in-vessel fusion power calibration system also advanced within the framework of the neutron calibration project.

Progress continues at the Neutral Beam Test Facility (NBTF) in Italy, where an ITER-scale negative ion source (SPIDER) and a full-scale neutral beam injector (MITICA) will be tested for ITER's powerful heating neutral beam system.

Two components delivered by Europe for SPIDER – a high voltage deck for power supply equipment and a vacuum vessel – became the first elements to be installed and tested at the site. Components for SPIDER's power

The first batch of cooling water piping reached ITER from India in 2015.

ITER Highly Exceptional Loads travel at night in order to minimize traffic disturbance. Pictured: one of the five stainless steel drain tanks shipped from the US in 2015 for ITER's cooling water system.

supply system were received from Japan and acceptance procedures were completed for the Indian beam dump delivered last year. Fabrication of the beam source (Europe) and high voltage bushing (Japan) is progressing well and procurement contracts were signed for diagnostics, control systems, and the acceleration grid power supply. The final design was completed for the last MITICA mechanical components and manufacturing started on the vacuum vessel.

The design and validation of the electron cyclotron system advanced in 2015 through successful final design reviews for the Japanese and Russian gyrotrons, a manufacturing readiness review for high voltage power supplies in Europe, and the fabrication of prototype diamond disks for the launchers. The Russian gyrotron demonstrated 1 MW operation for 1,000 seconds with reliability that exceeded requirements. The master models of the equatorial and upper launchers were updated to reflect changes to port plug dimensions and encouraging results were achieved in the US in the analysis of electron cyclotron transmission line performance against requirements.

The ion cyclotron antenna design was revisited to accommodate the evolving requirements for installation and the latest information on the tolerance of the vacuum vessel, while trying to minimize the shutdown dose rate. Prototypes of high heat flux components have been validated by Europe. The design of transmission line equipment in the Radio Frequency Heating Building was presented during a preliminary design review and number of components performed well during long-pulse high power tests in the US. A prototype radio frequency power source was also tested in factory at relevant power level for more than one hour, and later transported and integrated in a test facility specially developed for full testing in India. A high voltage power supply prototype was developed by India and a prototype of the plant control system is underway in collaboration with Control, Data Access and Communication (CODAC).

Plant Engineering Department (PED)

The Plant Engineering Department provides a fully qualified range of services and facilities for the operation of the ITER Tokamak. PED is responsible for the design, procurement and testing of electrical and power supply distribution, cooling water, cryogenics, vacuum, fuel cycle, remote handling, radioactive materials, radioactive waste management, and dismantlement.

In a major step forward for the project, a decision was reached in 2015 on the revised layout of the Tokamak Cooling Water System (TCWS). The final design solution will now have to find ways to mitigate the effect of activated cooling water on electronics while incurring the least possible impact on buildings and cost. The ITER TCWS team is now pursuing the engineering optimization of this challenging system, which is made up of thousands of components and at least 35 km of piping.

In September, the ITER Organization awarded the centralized contract for the procurement of all piping needed by the ITER plant, TCWS included. A number of contracts (CAD and software support, thermal-hydraulic analysis, stress analysis, thermomechanical design, I&C) were also awarded during the year for the system's final design and integration. In parallel, the team completed a resource-loaded schedule and earned value management (EVM) reports – the first ITER business unit to successfully implement EVM reporting. The optimization of the schedule and corresponding reduction in the length of time components will need to be stored on site has resulted in a very positive reduction in cost of the overall TCWS program.

The United States successfully delivered five large TCWS drain tanks to ITER in 2015. These nuclear-grade stainless steel tanks, which are subject to French regulations on pressure equipment (ESPN regulation), passed both their ESPN conformity assessment and French Nuclear Regulator (ASN) inspection. The first delivery of buried piping was also received for the component cooling water, chilled water and heat rejection systems from India, where the final design review milestone achieved in 2015 on the remaining scope of buried piping will open the way for the delivery of approximately 180 containers of piping next year. The procurement of pumps, plate heat exchangers, cooling towers, and ozone equipment is also advancing through supply contracts awarded by the main Indian contractor. The Cooling Water System Section collaborated closely with Domestic Agency colleagues to advance the final design of the systems under Indian scope so that the final interfaces with buildings and civil structures can be defined.

Three parties are associated in the procurement of the ITER cryoplant: Europe (the liquid nitrogen facility and auxiliary systems), India (interconnecting lines and cryodistribution equipment), and the ITER Organization (responsible for the direct procurement of the liquid helium plant). With the conclusion of the final design review for the liquid nitrogen (LN2) plant in Europe, the design of the ITER cryoplant is now finalized and manufacturing activities are progressing well. The first of the three identical liquid helium (LHe) plants is ready for delivery following successful acceptance procedures; cryogenic pumps passed factory acceptance tests in Japan (part of Indian scope); and India awarded two major design and fabrication contracts during the year for the procurement of the helium cryolines and the cryodistribution system.

A major manufacturing achievement was celebrated in December as 460 tonnes of cryostat base segments became the very first machine components to be delivered to the site.

Equipment continues to arrive on site for ITER's electrical power distribution networks – over 65 percent of material for the steady state power supply (SSEN) and 50 percent of material for the pulsed power supply (PPEN) has now been delivered. The SSEN substation transformers delivered last year by the United States were installed on the platform and all others successfully passed factory acceptance tests. The procurement of ancillary components for both networks also moved ahead, with the successful manufacturing and testing of power distribution components, the delivery of SSEN metallic structures, and progress in the manufacturing design of PPEN metallic structures.

The Electrical Engineering Division provided input to the Buildings, Infrastructure & Power Supplies (BIPS) Project Team for building scope related to electrical distribution and overall engineering support for the on-site distribution of electrical services and the specific needs of plant systems. The first on-site execution activities began for load centres and associated low voltage distribution, while the construction design progressed for the medium voltage load centres. In support of a global systems engineering approach to integration activities, the team carried out electrical simulations, stress test analyses, and requirements allocations. Technical support documents were also prepared for contracts planned in energy, electricity transport, operation/maintenance, and measurement devices.

In 2015 manufacturing was launched on the majority of coil power components. The series production of poloidal field AC/DC converters kicked off in China following the successful testing of the first unit and activities on the first reactive power compensator are underway; Russia completed type tests for the power cables and switching network resistors and delivered the first set of DC busbars and links to the ITER site; and Korea completed the fabrication and testing of converter transformers and the master controller for the correction coil power supply plant. The Electrical Engineering Division developed the conceptual design of the in-vessel power supply busbar in advance of the Procurement Arrangement planned with Korea and performed the layout integration in full compliance with safety requirements.

Work to propagate coil power supply instrumentation and control (I&C) to the suppliers and to the main CODAC architecture is advancing. The development of a large and complex model to perform steady state and transient analyses of the coil power system under normal and fault conditions will contribute to verifying the system-level consistency of design solutions. The integration of the entire coil power plant was improved through enhanced interfaces and a preliminary study was performed on the plant's installation and commissioning sequences.

Feeders are the lifeline of the ITER magnet system, relaying electrical power, cryogens, and instrumentation. In China, the first manufacturing readiness assessment for a magnet feeder component opens the way to the start of manufacturing. Photo: ITER China

Radial plates have the role of supporting toroidal field conductors within their coils cases. At a manufacturing factory in Europe, technicians fit the cover plate onto one 5m x 16m plate. Photo: F4E

The cable engineering team supports all systems in the production of electrical diagrams and load calculations, manages the cable database, and designs the cable trays and cable routing throughout the ITER site. In 2015, the Executive Project Board approved a strategy for the centralized procurement and installation of cables once the buildings are ready for equipment. The team defined items to be procured for the Assembly, Site Services and Cleaning buildings through bills of materials and finalized the layout of electrical cubicles in the Tokamak Complex. In order to qualify equipment that will be subjected to static magnetic field, the first phase of testing was launched based on a contract signed last year.

Procurement is now underway on all four of ITER's major remote handling systems following the signature in June of the fourth and final Procurement Arrangement with Europe for the cask and plug system. Contracts were signed with industrial suppliers in Japan for the blanket remote handling system and in Europe for the neutral beam remote handling system; R&D trials for this last system in the UK successfully demonstrated prototype tooling for the cutting and welding of neutral beam cooling pipes. Four years of handling trials on full-scale divertor mockups also successfully concluded at the Divertor Test Platform in Finland; these trials have led to design improvements that increase the reliability and ease the remote installation process of the divertor cassette locking systems.

Procurement is now underway on all four of ITER's major remote handling systems: the blanket, divertor, neutral beam, and cask and plug remote handling systems.

A coherent schedule for the Hot Cell and Radwaste facilities has been developed that aligns considerations for hot cell remote handling, radwaste processing, building schedules and resources. An interim conceptual design for the facilities, including a preliminary safety analysis and building loads, was communicated to Europe. Collaboration continues with Korea on radwaste processing.

A newly formed working group studied the issues of radwaste treatment, waste disposal in France and site decommissioning during the year. Participants from the ITER Organization and Agence Iter France have begun the optimization of the future nuclear waste strategy, an activity that involves ANDRA, France's permanent repository.

A high-level long-term schedule and associated resource structure were developed for Tritium Plant activities in alignment with the ITER Research Plan, nuclear safety licensing and plant commissioning. Systems designs advanced through new computer modelling capabilities, in particular for the isotope separation system. The Tritium Plant Section completed the final design of the detritiation system captive pipe, validated the water detritiation system separation column through modelling, and submitted a report on the validation of scrubber column technology to the French Regulator (ASN). In other 2015 milestones, the first six water detritiation system tanks were delivered for installation in the Tritium Plant building, the preliminary design of the radiological and environmental monitoring system (REMS) was approved for the Tokamak Complex, and approval was given on the first version of the building's preliminary safety analysis.

As part of an agreement signed in 2014 for the joint procurement of the detritiation system, the ITER Organization and Japan signed the Atmosphere Detritiation System Procurement Arrangement in September. In the first phase of this arrangement, Japan will perform qualification testing on the effectiveness and the operability of the detritiation system. In the area of fuelling and wall conditioning, successful design reviews were held for the pellet injection system flight tubes (preliminary) and the gas injection system manifold system (final). R&D continues in the United States to optimize the frozen pellets of deuterium and tritium that will be injected into the vacuum vessel to fuel the reaction.

The Vacuum Section pursued the standardization of vacuum components in 2015 as a way for the ITER Organization and Domestic Agencies to save cost in qualification and purchases. It initiated a project-wide standardization agreement on vacuum instrumentation and signed a specific agreement with the United States to centralize the procurement of vacuum pipework. The Section also continued to provide cross-project support, perform component qualification and materials testing in an on-site laboratory, and offer practical training in leak-testing and vacuum-related areas. The assembly sequences for complete vacuum systems were drafted and the commissioning process for the main ITER vacuums was developed and iterated through First Plasma.

All of the main components of the torus pre-production cryopump are now ready for final assembly. The successful development of this component, which will serve as a spare for ITER's eight torus cryopumps, involved 20 companies and served to confirm manufacturing processes. In addition, design activities progressed on other vacuum systems: the preliminary design phase for the front-end cryopump distribution system was brought to a close; the design and prototyping of the warm regeneration lines progressed; the full-size cryogenic roughing pump was installed at a cryogenic test facility in the United States where a first, limited, cold test was carried out; and early validation results were achieved for the conceptual design of the dust filtering system.

Construction Department (CST)

The Construction Department ensures that all ITER facilities are designed and constructed according to ITER Organization requirements; manages transport, logistics and materials management services; and plans, organizes and executes assembly-phase works on the ITER site including the assembly, installation, completion and testing of the ITER Tokamak and plant until turnover to the operation teams for start-up and commissioning. CST works closely with the engineering departments to receive the necessary specifications, documentation, drawings and data for construction, with the Environmental Protection & Nuclear Safety Division to implement the processes and procedures that ensure compliance with French nuclear regulations, and with the European Domestic Agency in relation to the detailed design and construction of the buildings and site infrastructure.

The Construction Department was created in 2015 to group all ITER Organization activities related to building construction and the management of facilities (former Buildings & Site Infrastructure Directorate) with overall construction management for the assembly and installation phase of the machine and plant (former Assembly & Operations Division). Members of the Department participate in the joint ITER Organization-European Domestic Agency Project Team for Buildings, Infrastructure & Power Supplies (BIPS), which was created in July as an integrated body with one goal – delivering the buildings and technical infrastructure of the ITER site.

In the centre of the ITER worksite, the walls and columns of the lowest basement level (B2) of the Tokamak Complex took shape in 2015 through the successful completion of more than 250 individual concrete pours. Propping and formwork for the next level began according to schedule in July and, by the end of the year, the B1-level basemat was in place for the Diagnostic Building.

The creation of the first 200° segment of the ITER bioshield in October capped seven months of preparatory work to create the dense and very complex reinforcement of the circular, 3.2-metre-thick structure, which has a structural role to play in anchoring the radial walls of the cryostat crown in addition to protecting workers and the environment from radiation. A full-scale construction mockup was realized on site to demonstrate constructability before proceeding.

Work on the huge steel frame of the Assembly Building ended in September as the 730-tonne roof structure was lifted and secured into place. Cladding activities began on the north side of the building while the first rails were installed 45 metres above the basemat to support massive overhead cranes. In other areas of the site work started on the foundations of the ITER cryoplant, the basemat of the Cleaning Facility was poured, the

In the basement of the ITER Tritium Plant, six storage tanks will handle the water involved in the tritium recycling process. Europe delivers all six during the year.

By the end of the year, wooden formwork and lattices of rebar completely cover the lower level of the Diagnostic Building. The first concrete for the B1 basemat is poured in November..

structure of the Site Services Building progressed to the cladding stage, ground work was initiated for the Radio Frequency Heating Building, and a major segment of the technical gallery running along the Poloidal Field Coils Winding Facility was completed and closed up.

The first Highly Exceptional Load travelled along the ITER Itinerary in January – an inaugural convoy paving the way for approximately 250 major loads to be delivered along this specially adapted route during ITER assembly. The US-procured electrical transformer was followed along the Itinerary during the year by deliveries from Europe (water detritiation tanks), the United States (cooling water system drain tanks and additional electrical transformers), and India (cryostat components).

Upon reaching the ITER site, components are stored in one of ITER's four warehouse facilities; the largest of these is a 10,000 m² building that was completed in 2015 within budget under the oversight of the Facilities, Logistics & Materials Division. A robust material management system is now in place that centralizes material data from the Domestic Agencies, and that will be a strong ally in managing logistics, warehousing and assembly activities. Mid-year, the very first plant components were transferred from storage to their permanent home on site – four electrical transformers that were installed near the high-voltage substation.

In 2015, the walls and columns of the lowest basement level (B2) of the Tokamak Complex took shape through the successful completion of more than 250 individual concrete pours.

In 2015, an agreement was signed with the Host Organization, CEA, for the design and construction of a new access road that will improve the reception of components as well as provide an area for additional storage space. Significant extensions were made to the perimeter security fence and a tender was launched for a new temporary office block to house ITER assembly contractors. Finally, a review of transportation services for staff led to cost-saving modifications in bus service, the introduction of electric shuttle cars, and a new web-based carpooling service that was developed in conjunction with IT.

The Construction Management Division plans, coordinates and ensures the supervision of all site construction works during the assembly phase including testing and turnover to operations. In an important milestone this year, the strategy for the assembly and installation of ITER was approved. This comprehensive document defines the approach to the management of works and the roles and responsibilities of the ITER Organization, the Domestic Agencies and contractors.

At the same time, the ITER Council endorsed the ITER Organization procurement strategy on how the management and execution of construction works for assembly and installation will be tendered, as well as the strategy for industrial contracts. In order to inform companies about upcoming procurement opportunities, a dedicated Industry Information Day was held in May that attracted 194 participants from 137 firms. During the day-long program, the ITER Organization presented the planned work scope of the assembly and installation phase as well as tender rules and regulations and specific work packages. A major call for tender was launched in 2015 for the industrial partner that will assist the ITER Organization in the management of the installation and assembly of the ITER Tokamak and plant – the Construction Management-as-Agent (CMA). Seven consortia were pre-qualified to participate in the tender, which will be awarded in 2016.

In collaboration with IT, the systems for configuration management, document management, and the planning and controlling of construction work were finished and tested (Intergraph SmartPlant® Construction and SmartPlant® Foundation).

Responsible for the execution of machine assembly, the Tokamak Assembly Division is working now to ensure that constructability is taken into account in the design and fabrication of components and systems, and to develop a technically robust, code-compliant, cost-effective and rational approach to assembly activities. In 2015, the Division delivered the Construction Master Schedule describing the processes to assemble and install each component, as well as subsidiary detailed schedules and a construction cost estimate. This work was underpinned with nearly 200 process descriptions covering 80 percent of work scope.

The ITER Organization issued its first major contract for machine assembly tooling to cover the in-vessel access and handling systems and associated training facility, and launched a call for tender for the design and manufacture of purpose-built tools and platforms for machine assembly. Contracts for engineering services were also extended to mid-2019 in order to continue to provide support in the development of baseline documentation and construction preparation. Design and fabrication activities for specialized tooling also progressed during the year: in Korea, manufacturing has begun on the giant sector sub-assembly tools that will pre-equip vacuum vessel sectors before installation in the Tokamak Pit and prototypes of customized tools for vacuum vessel welding have been built and tested at the ENSA factory in Spain.

Science & Operations Department (SCOD)

The Science & Operations Department supports ITER construction and operation in all matters related to physics performance and plasma control requirements, the assessment of plasma-related specifications for engineering systems, and the development of operational and research plans for the exploitation phase. The Department is also in charge of the systems and infrastructure required for machine and facility operation, in particular those related to central instrumentation and control, and plans for the operation, maintenance and inspection of all ITER plant systems.

The Science Division implements an extensive program of experimental, simulation and theory R&D via collaborations with Member fusion communities and the International Tokamak Physics Activity (ITPA), whose aim is to improve quantitative predictions of all aspects of fusion plasma behaviour in ITER scenarios and to resolve outstanding R&D issues impacting ITER design decisions. In 2015 areas of particular ITPA focus included plasma-wall interactions (tungsten material damage, scrape-off layer heat transport, ELM power loading and divertor detachment); confinement and modelling (plasma energy, particle core and pedestal transport, edge plasma stability, ELM control, fast particle behaviour); and stability and control (operation scenarios, the control of magnetohydrodynamic instabilities, and disruption mitigation).

To strengthen the involvement of the worldwide fusion community directly in ITER – especially in the areas of simulation and theory – the ITER Organization has created the Scientist Fellow Network.

The ITER Organization moved closer in 2015 to a final decision on the divertor's tungsten monoblock surface shape, which must be optimized to limit power loading in the case of off-normal plasma events. Through R&D tasks coordinated worldwide, the physics basis for power loading on lead edges has now been consolidated and a final decision is expected in 2016 ahead of divertor target procurement.

In April, a powerful new tool for plasma edge modelling – SOLPS-ITER – was unveiled to users and developers from six ITER Members. Based on a code package used since the 1990s to simulate the critical buffer region between the hot core of the ITER plasma and solid wall elements (called the scrape-off layer, or SOL), the new, more versatile package incorporates the most recent developments made by the SOLPS community. A five-day training session was held and others are planned to encourage the widest possible use of the code in the simulation of ITER plasma experiments. The 3D simulation capability of neutral gas dynamics was also upgraded through the completion of a code that will help to determine the optimum locations for gas injection points behind the ITER blanket and, later, in the area of the divertor.

In support of Tritium Plant design, the Science Division assessed the likelihood of tritiated ammonia in the exhaust stream as a result of nitrogen seeding, which will be used to control the divertor heat flux. It also contributed to the design of diagnostics for in-vessel tritium retention and dust monitoring and performed the first calculations of fuel retention in thick, ITER-relevant beryllium co-deposit layers, providing early evidence of slower-than-anticipated outgassing.

The ITER Organization continues to develop the ITER Modelling and Analysis Suite framework for integrated modelling and is supporting its remote use through test installations at fusion research institutes in the ITER Members. To strengthen the involvement of the fusion community directly in ITER – especially in the areas of simulation and theory – the ITER Scientist Fellow Network was initiated in 2015 for scientists whose home institutions agree to have them focus their research on priority issues in physics design or operation questions related to ITER. In 2016, recruitment is planned in four priority areas: Edge Localized Mode (ELM) control, disruption mitigation, edge plasma modelling, and integrated modelling.

The Science Division carried out a complete review of the physics requirements for the ELM coils with the participation of many Member experts; this data will now be used by the Magnet Division to create a revised set of electromagnetic and thermal loads. In further studies of ITER plasma fusion performance, the Division performed the first fully integrated modelling evaluation of fuelling requirements for all phases of operation and a re-assessment of the behaviour of energetic ions during ITER's reference high power scenarios. Additionally, it contributed to the first experimental demonstration of the processes that drive core tungsten transport in ITER.

In collaboration with the Control System Division, the preliminary design of the ITER Plasma Control System (PCS) advanced through a framework service contract and outside support; development is on track for the preliminary design review in late 2016. New contracts were also launched to strengthen the physics basis for the mitigation of high energy runaway electrons in support of the design of the disruption mitigation system.

In the context of the development of the long-term schedule, the Science Division continues to explore a range of candidate plasma scenarios for ITER through detailed simulation studies including First Plasma, early low-current non-active operation, and burning plasmas. Studies were conducted on the impact of disruptions on plasma-facing elements (component lifetime, dust generation) and the heating of magnets due to AC losses. ITER participated in the 2015 experimental campaign at the KSTAR tokamak in Korea to demonstrate the candidate plasma profile control technique proposed as the basis for high-performance operation.

The Control System Division is responsible for integrating 200 local plant control systems into a coherent whole for the operation of ITER. In 2015, it released two additional versions of the conventional software package CODAC Core System, used by 62 organizations or companies representing all of the ITER Members. A Division initiative to supply free standard hardware to plant system suppliers in the form of instrumentation and control (I&C) integration kits was commended by the ITER Council Science and Technology Advisory Committee (STAC). Approximately one-third of the kits have been shipped and training has been provided in their use.

The Machine Protection Panel – a cross-disciplinary coordinating board for machine protection that reunites system responsible officers from machine operation, plasma operation, and control systems – proved its effectiveness in advancing the understanding of and the specifications for machine protection functions. A proposal to centralize plant safety systems within the nuclear safety control system was accepted as a means of facilitating licensing, qualification and integration, of optimizing space and, ultimately, of generating cost savings for the project. Capping three years of collaboration with industry, a certificate of compliance was issued for the safety programmable controller selected for nuclear category C and environmental qualification is now underway. In the wake of a successful preliminary design review for the central safety system, the contract for final design and supply is running according to schedule.

Division staff attended dozens of plant system design reviews to ensure that I&C systems are designed, implemented and integrated in such a way that ITER can be operated as a fully integrated and automated system. A prototype diagnostic plant I&C system was successfully demonstrated on a real diagnostic in the dedicated CODAC control room located at ITER Headquarters and the technical specifications for the supply and installation of the site-wide network infrastructure were finalized and merged with the general electrical construction contract. Finally, the Division took over the responsibility for the access control and security system and finalized all technical specifications for suppliers. The contract process will be initiated in early 2016.

The Operation Management Section was established in April to develop the overall operations framework and operational plans for the ITER integrated commissioning and exploitation phases in close liaison with the Safety Department for regulatory and safety aspects. The establishment of clear specifications and procedures for ITER machine operation needs also contributes to CODAC and plant system design completion.

The Section established high-level Management and Quality Program (MQP) documents on operation, maintenance and inspections; published policies on human and organizational factors and on the management of beryllium; and commenced the review of the ITER maintenance program for approval early in 2016. A concept for the functional organization of the ITER operations phase was reported to the ITER Council in November and the strategy and process documents will now be cascaded down to all ITER facilities. Through a contract with the Culham Centre for Fusion Energy (UK), the ITER Organization is benchmarking its plans for integrated commissioning.

European contractors successfully complete cryogenic, high voltage and leak tests on the first full-size, superconducting prototype of a toroidal field coil "double pancake" in March. Each of ITER's giant, D-shaped toroidal field coils will contain seven double pancakes. Photo: F4E

In addition to the specific analysis of detailed work schedules and updated resource estimates that the Department contributed to the project-wide schedule exercise – an activity that required a substantial allocation of resources during the year – SCOD also took responsibility for the adaptation of the integrated commissioning and operations planning and, in particular, the ITER Research Plan, to the revised schedule. With the aim of making the transition from First Plasma to full deuterium-tritium operation as rapidly

Radio-frequency devices called gyrotrons will generate microwave beams over a thousand times more powerful than a traditional microwave oven. In April, the continuous wave gyrotron prototype successfully passes final factory acceptance tests in Europe. Photo: F4E

as possible, the revised Research Plan was prepared in close cooperation with the team coordinating the schedule revision activity to ensure consistency between the experimental planning and the delivery, installation and commissioning of plant and auxiliary systems.

In 2015, SCOD members published more than 100 papers in refereed journals on plasma physics and fusion energy and participated in a number of fusion and control conferences. The Department also contributed to a range of training activities for young fusion researchers, participating in several fusion physics summer schools, hosting interns at Masters and PhD level, and overseeing the work of two of the Monaco-ITER Postdoctoral Fellows. In addition, in collaboration with the Aix-Marseille University, the University of Science and Technology of China and the Institute for Plasma Physics of the Chinese Academy, the 8th ITER International School was organized in Hefei, China to promote the training of postgraduate students and young researchers.

Finance & Procurement Department (FPD)

The Finance & Procurement Department is charged with the preparation of in-kind Procurement Arrangements, the placement of in-cash contracts and task agreements through competitive process, sound financial and budget management, the preparation and management of the annual and lifecycle budgets, and the presentation of the annual ITER Organization accounts.

Finance & Procurement worked closely in 2015 with technical responsible officers and the Project Control Office to prepare resource estimates for the remainder of the construction phase ending with First Plasma. This bottom-up exercise, which considered future procurements, hardware needs, external contracts and staffing, was an important part of the project-wide effort to update the long-term schedule.

As part of its regular activity, the Department closely monitored the execution of the 2015 commitments, payments and income budgets, and distributed reports internally (every month) and to the Members and the Domestic Agencies (quarterly and semi-annually). By working with the technical units to identify and recover variances, the ITER Organization executed 90 percent of its commitments budget and 86 percent of its payments budget for the year. The Department also assisted the Director-General in the management of the Reserve Fund, which was created in 2015 to address known and unknown project risks that materialize during construction, including unavoidable design changes introduced to complete the project as early as possible. FPD now reports monthly to the Central Team Management Board and bi-annually to the ITER Council on the overall status of the Reserve Fund.

In the eight years since the ITER Organization signed its first Procurement Arrangement (November 2007), a total of 91.2 percent of allocated in-kind value has been committed through 106 Procurement Arrangements. In 2015 the Department assisted in the finalization and signature of two Procurement Arrangements and one Complementary Diagnostic Procurement Arrangement. It also facilitated the transfer of in-kind scope – wherever economies of scale or improved integrated project management could be realized – from the Domestic Agencies to the ITER Organization.

The major Construction Management-as-Agent (CMA) call for tender for the management and coordination of assembly and installation work execution was launched on time in 2015 in respect of schedule milestones. The Department also placed a number of large contracts for the fabrication of the Tokamak Cooling Water System and its centralized piping and fittings, the procurement of mechanical handling equipment for in-vessel assembly, and remote handling maintenance engineering services. Through actions such as industry information days, tenderer conferences and market surveys, the Department works to keep industry well informed of all upcoming procurements.

In order to ensure the smooth operation of commitments and payments, the Department verified and executed approximately 68,000 transactions. These included the verification of commitments, de-commitments, invoices, salaries, and other claims; the registration of bank guarantees; the issuance of debit notes, receipts, small-value purchase orders, invitation letters, and reimbursement requests; and the resolution of errors with invoices, cost allocations, and purchase orders.

Following the production and certification of the 2014 annual accounts in February, the experts of the Financial Audit Board, representing all seven Members, issued an unqualified audit opinion and noted the proactive initiatives taken to improve accountability and transparency in financial management, contract administration and budgetary control. The expert group conducted a second review of the 2015 trial balance for the period of 1 January to 30 June, including an examination of expenditures and contract administration.

In the eight years since the ITER Organization signed its first Procurement Arrangement (November 2007), a total of 91.2 percent of allocated in-kind value has been committed through 106 Procurement Arrangements.

Human Resources Department (HRD)

Responsible for the human resource strategy and policies of the ITER Organization, the Human Resources Department manages a fully integrated range of services (recruitment, training, appraisal, salary, travel and social insurance) and develops and manages the staffing plan in relation to organizational needs and forecasts.

The Human Resources Department accompanied the restructuring of the ITER Organization by creating new business units, re-aligning job descriptions, cascading strategic objectives down to staff performance objectives, and recruiting new personnel. In cooperation with all departments and divisions, the team conducted a forward-looking staff resource exercise to plan for organizational needs during assembly, installation and commissioning, taking full account of the best use of existing resources. Work on this staffing plan will continue in 2016 for presentation to the ITER Council.

In 2015, the Department managed 92 appointments, 42 departure, and 30 renewal decisions, and adapted 650 notifications of assignment to the new organizational structure. For 88 posted vacancies, the ITER Organization received 2,400 applications through the ITER Domestic Agencies and conducted 370 interviews. By 31 December, 642 people were employed by the ITER Organization, including 5 postdoctoral researchers funded under the Monaco-ITER Partnership Arrangement and 25 staff funded by the US Domestic Agency for work on the Tokamak Cooling Water (24) and vacuum (1) systems; the Department also managed 20 visiting researchers from the Domestic Agencies, 29 student interns, and 51 expert contracts. Training sessions organized in security, design planning, nuclear safety culture, and managerial, scientific and technical skills benefitted 1,100 attendees.

In support of the Director-General's Action Plan, the Department assisted in the creation of a new non-staff category – the ITER Project Associates. Under this new status professionals from the fusion institutions and laboratories of the ITER Members, while remaining in the employ of their home institution, will provide expertise in a specific domain to ITER through a contract of association. The first ITER Project Associates will be recruited in 2016.

The Department also led a broad review of employment conditions within the ITER Organization and submitted updated proposals for the Staff Regulations, internal administrative circulars, and internal regulations to the Council Preparatory Working Group (CPWG) for review before approval by the ITER Council. Pursuing work begun last year, further improvements were made to reporting systems and processes for gains in efficiency in the context of increasing numbers of staff.

In addition to performing appraisal, salary, mission reimbursement, and social insurance services for all staff, part of the Department's mission is to support social dialogue within the Organization. Human Resources maintained the dialogue with the Staff Committee and the ITER Staff Association (ISA), coordinated the activities of the Advisory Board on Pension and Social Insurance and, where necessary, the Committee for Health & Safety. An increasing number of litigations were also managed, including court cases, appeals and mediation requests. The Department also acts as the ITER Organization point of contact for the French administration (labour inspectorate, social security).

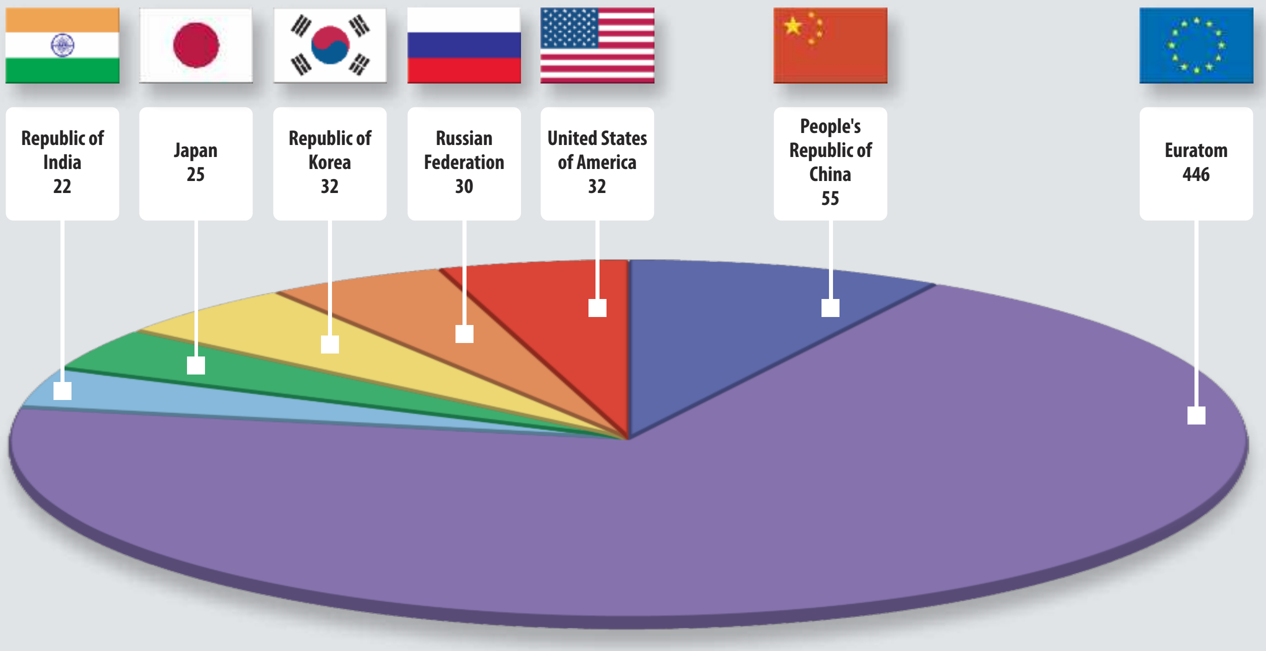
The first 200-degree segment of the ITER bioshield (inner circle, light grey) is poured in October.

Members of the Buildings, Infrastructure and Power Supplies (BIPS) Project Team, plus European contractors, pose for a group photo after the successful two-day operation to lift the roof structure of the Assembly Building.

STAFFING & FINANCIAL TABLES

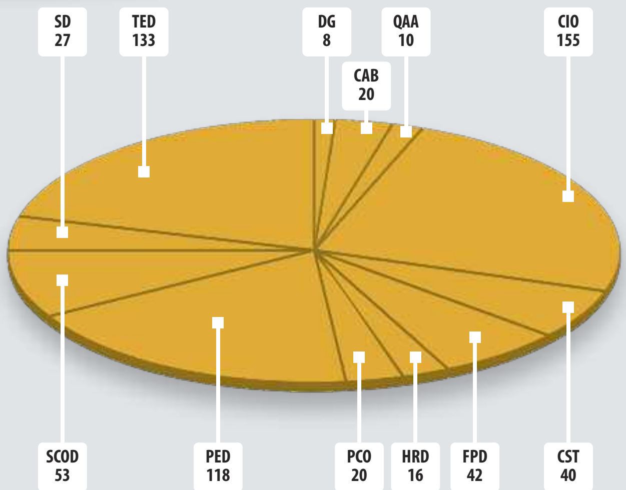
Staffing tables

Staff by Member	31/12/2013	31/12/2014	31/12/2015
People's Republic of China	30	50	55
Euratom	339	412	446
Republic of India	25	19	22
Japan	33	29	25
Republic of Korea	32	33	32
Russian Federation	28	30	30
United States of America	28	36	32
Total	**515**	**609***	**642****



Staff by department

as of 31/12/2015***	Professional	Support	TOTAL
DG	7	1	8
CAB	10	10	20
QAA	5	5	10
CIO	62	93	155
CST	30	10	40
FPD	18	24	42
HRD	7	9	16
PCO	11	9	20
PED	71	47	118
SCOD	44	9	53
SD	18	9	27
TED	91	42	133
TOTAL	**374**	**268**	**642**



** Includes 6 Monaco Postdoctoral Fellows and 16 Tokamak Cooling Water System staff.*

*** Includes 5 Monaco Postdoctoral Fellows and staff funded by the US Domestic Agency for work on the Tokamak Cooling Water System (24) and vacuum system (1).*

**** For the full names of organizational units, see pages18-41.*

Financial tables

Commitments Execution – Cash And Short-Term In Kind (Task Agreements and Secondments)*

Amounts in thousands of Euro

Budget Headings	Total Commitment Appropriations 2015	De-commitments and Transfers of previous years' Total Commitments	Total Commitments 2015	Unused Commitment Appropriations carried forward to 2016
	1	2	3	4 = 1 + 2 - 3
Title I Direct Investment (Fund)	74,598	4,177	66,898	11,878
Title II R&D Expenditure	3,034	712	2,092	1,654
Title III Direct Expenditure	137,266	6,126	135,475	7,917
Total Commitments	**214,899**	**11,016**	**204,465**	**21,449**

* Without the IO reserve

Payments Execution – Cash And Short-Term In Kind (Task Agreements and Secondments)*

Amounts in thousands of Euro

Budget Headings	Total Payment Appropriations 2015	Total Payments 2015	Unused Payment Appropriations carried forward to 2016
	1	2	3 = 1 – 2
Title I Direct Investment (Fund)	64,918	58,064	6,854
Title II R&D Expenditure	8,021	5,875	2,145
Title III Direct Expenditure	157,470	134,045	23,425
Total Payments	230,408	197,984	32,424

* Without the IO reserve

Contributions From Members

Amounts in thousands of Euro

	Cash and Short-Term In Kind			
Members	Cash	Task Agreements and Secondments	Procurement Arrangements	Total
	1	2	3	4 = 1 + 2 + 3
Euratom	66,767	3,192	66,265	136,224
People's Republic of China	21,835	-	16,949	38,784
Republic of India	22,320	19	10,859	33,199
Japan	14,029	-	47,458	61,487
Republic of Korea	12,342	233	9,265	21,839
Russian Federation	18,561	-	38,536	57,097
United States of America	13,755	2,196	22,686	38,637
Total Contributions	**169,608**	**5,640**	**212,018**	**387,266**

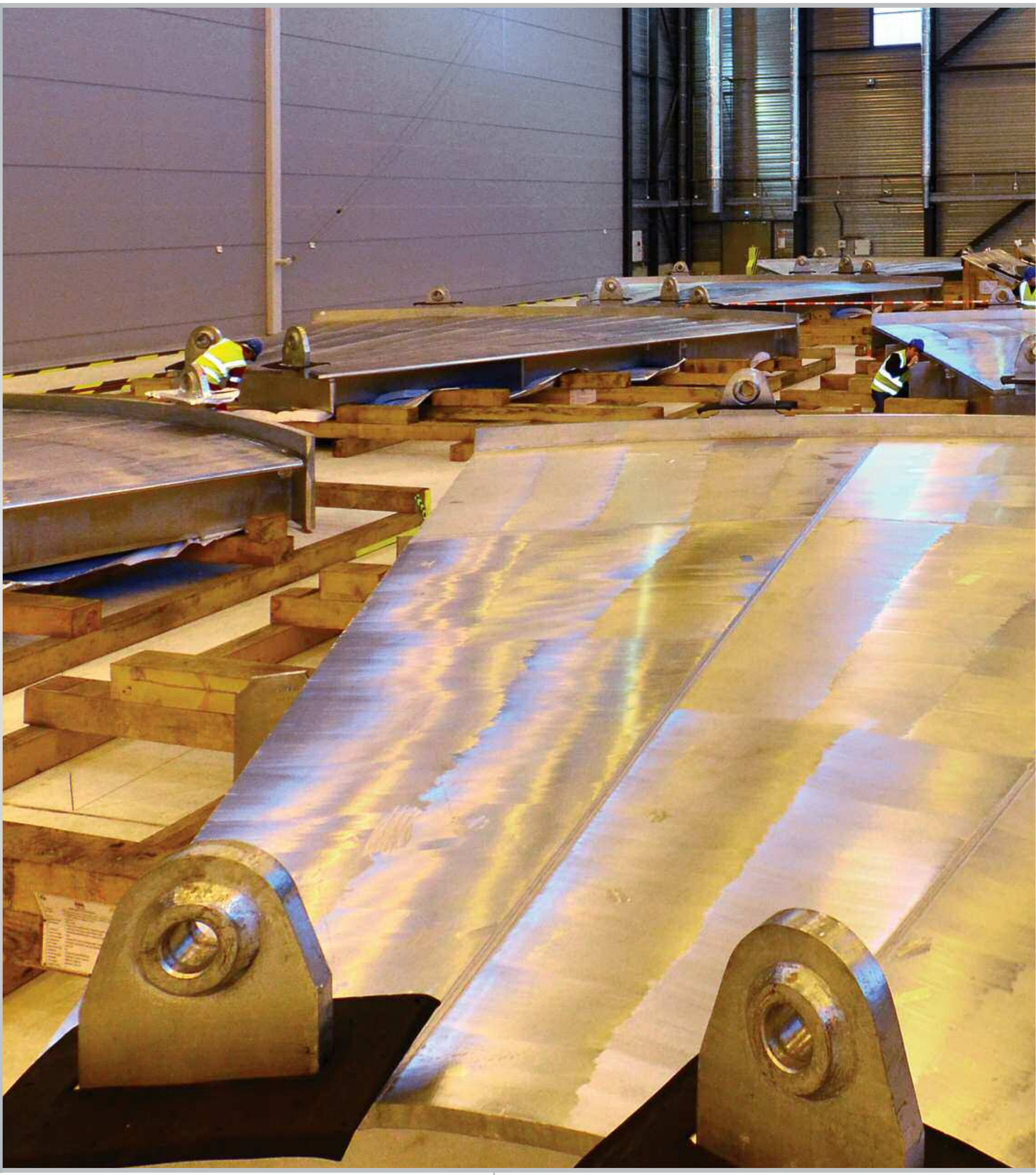
Cumulative In-Kind Payments Through 31 December 2015

	Procurement Arrangements	
Members	IUA *	in million EUR
Euratom	127,480	209.61
People's Republic of China	28,034	47.06
Republic of India	21,526	35.60
Japan	105,645	173.26
Republic of Korea	60,411	100.78
Russian Federation	54,379	91.33
United States of America	25,238	41.73
Total	**422,714**	**699.38**

* ITER Unit of Account

These tables show tabulations in thousand/million Euros which could cause minor differences due to rounding.

The first twelve segments of the massive ITER cryostat are shipped from India to ITER in 2015 – the very first Tokamak components to reach and be stored on site.



DOMESTIC AGENCY
PROCUREMENT HIGHLIGHTS

Procurement highlights key

- R&D and manufacturing milestones
- Major contracts
- IO-DA milestones
- Completed package

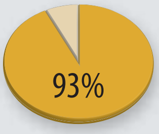
The figures on the following pages are adjusted annually for changes in credit value due to Procurement Arrangement Refinements (PAR) and Additional Direct Investments (ADI) related to Project Change Requests. Please note that 2015 figures supersede all previously published figures.

ITER CHINA (CH-DA)

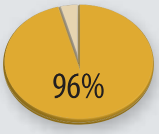
www.iterchina.cn

Procurement Arrangements*

Thirteen PAs signed since 2007 representing…



93% in number



...and 96% of the total value of CN in-kind contributions.

74 design or fabrication contracts related to ITER procurement have been signed with laboratories and industry.

Chinese procurement highlights in 2015 | **% of ITER system procured by China**

Magnet Systems

Toroidal Field Conductor — *7.5%*
- All 11 conductor unit lengths completed and delivered to receiving DAs

Poloidal Field Conductor — *62%*
- All 16 PF5 unit lengths produced and delivered to ITER site
- All 12 PF2 unit lengths produced and ready for shipping
- All niobium-titanium (NbTi) strand produced and ready for FAT

Magnet Supports — *100%*
- MRR meetings ongoing in preparation for manufacturing

Feeders — *80%*
- Most qualification tasks completed with the exception of joint insulation and HV cable thermal intercept
- Three MRR held for series production, including first for cryostat feedthrough (PF4)
- Series production launched
- High Temperature Superconductor prototype current lead successfully tested at 10 kA (correction coil type) and 68 kA (toroidal field type)

Correction Coils — *100%*
- Qualification tasks for winding, joint, helium inlet/outlet, vacuum pressure impregnation and filler material completed
- Raw material for coil cases hot-rolled and extruded in prototype trials
- Remaining tasks (case material/section, case enclosure, terminal service box) ongoing
- First pancakes wound for bottom correction coil 1 (BCC1)

Correction Coil and Feeder Conductors — *100%*
- Manufacturing completed on all correction coil and feeder conductors

Power Systems

Pulsed Power Electrical Network (PPEN) — *100%*
- Two component batches delivered to ITER; site delivery acceptance tests successfully performed
- Over 50% of material now delivered

AC/DC Converters — *55%*
- Successful MRR for the poloidal field converter package; series production launched
- Poloidal field converter prototype accepted as first production unit by IO; FAT successfully completed

Reactive Power Compensation — *100%*
- Thyristor controlled reactor and third filter reactor manufactured; FAT successfully conducted and accepted by IO
- First thyristor unit successfully manufactured
- First control and interlock system unit successfully manufactured

Blanket

Blanket First Wall — *12.6%*
- Enhanced heat flux mockups passed high heat flux testing
- Manufacturing equipment commissioned for beryllium first wall

Blanket Shield Block — *50.2%*
- Shield block qualification phase completed
- One block of forging material completed for machining
- MRR on machining completed

Fuel Cycle

Gas Injection System — *100%*
- FDR concluded for gas injection manifold system
- Preliminary design of gas valve boxes ongoing; physics requirements as design input under discussion

Glow Discharge Cleaning — *100%*
- Preliminary design and interface discussion ongoing for temporary/permanent electrodes

Diagnostics

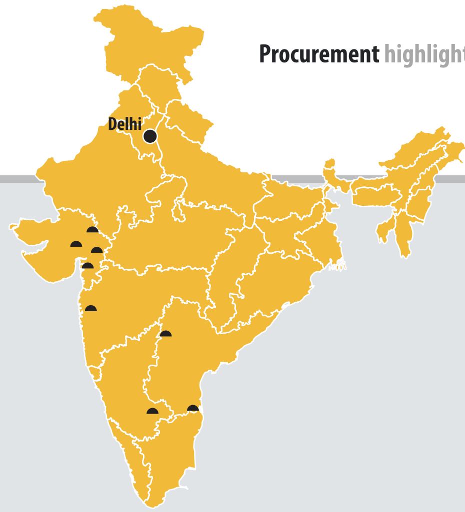
Diagnostics — *3.22%*
- PDR held for neutron flux monitor (equatorial port #7)
- Preliminary design ongoing for radial x-ray camera, equatorial port 12 integration, and remaining neutron flux monitors
- Contract signed for divertor langmuir probe design

Abbreviations • **ANB** Agreed Notified Body • **CDR** Conceptual Design Review • **DA** Domestic Agency • **FDR** Final Design Review • **I&C** Instrumentation & Control • **IO** ITER Organization • **FAT** Factory Acceptance Tests • **MIP** Manufacturing & Inspection Plans • **MRR** Manufacturing Readiness Review • **PA** Procurement Arrangement • **PDR** Preliminary Design Review

* Does not include Complementary Diagnostic Arrangements.

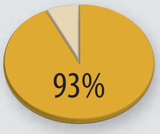
ITER INDIA (IN-DA)

www.iter-india.org

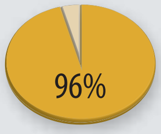


Procurement Arrangements*

Fourteen PAs signed since 2007 representing…



93% in number



...and 96% of the total value of IN in-kind contributions.

20 design or fabrication contracts related to ITER procurement have been signed with industry and R&D organizations.

Indian procurement highlights in 2015 — **% of ITER system procured by India**

Cryostat And Vacuum Vessel Pressure Suppression System

Cryostat — 100%

- Tier-1 base section components successfully manufactured and shipped to ITER
- Fabrication of Tier-2 base section components underway
- Start of mockup activities for lower cylinder
- FDR held for rectangular bellows
- Technical documentation completed for torus cryopump housing

Vacuum Vessel Pressure Suppression System — 100%

Cryogenic Systems

Cryolines & Cryodistribution — 100%

- Contracts awarded for Group-X cryolines, cryodistribution system, and warm lines
- PDR conducted for Lot Y2 and Lot Y1 cryolines; FDR held for Lot Y2 cryolines
- Prototype cryoline 1: manufacturing, installation and cold test completed
- Prototype cryoline 2: manufacturing started after successful conclusion of MRR
- Successful completion of qualification and performance tests on cold circulators

Heating & Current Drive Systems

Diagnostic Neutral Beam (DNB) Power Supply and Beam Line — 100%

- Beam source prototyping completed; manufacturing in progress
- Contracts awarded for DNB components (residual ion dump and neutralizer)
- Vacuum vessel for DNB test facility completed and delivered
- Manufacturing progressed for Acceleration Grid Power Supplies (AGPS); successful FAT conducted
- DNB AGPS delivered to IN-DA test facility for further installation/testing

Neutral Beam Test Facility (NBTF) Components (beam dump and 100 kV power supply) — 2%

- SPIDER beam dump Final Acceptance Test successfully completed at NBTF
- Components manufactured for SPIDER AGPS (transformers, switch power supply modules)

Ion Cyclotron Radio Frequency Power Sources — 100%

- Diacrode-based amplifier system installed, integrated at IN-DA laboratory; preliminary tests satisfactory
- Factory Acceptance Testing for tetrode-based system in progress

Ion Cyclotron Heating & Current Drive Radio Frequency Power Supply (8 out of 18) — 44%

Electron Cyclotron High Voltage Power Supply — 30%

Electron Cyclotron Radio Frequency Gyrotron (2 gyrotrons out of 24) — 8%

- Development of test facility at IN-DA laboratory
- Procurement, fabrication and testing of components ongoing for R&D/experimental purposes

Cooling Water Systems

Heat Rejection System, Component Cooling Water System, Chilled Water System — 100%

- FDR held for Lot-2 and Lot-3 piping
- First batch of Lot-1 piping delivered to ITER
- Manufacturing, inspection, testing and delivery of pipes, piping spools, fittings underway
- Equipment design underway
- MRR held for manual valves

Vacuum Vessel

In-Wall Shielding Block Assemblies — 100%

- Factory Acceptance Tests successfully performed for several batches of in-wall shielding components
- First shipments of components (support rib lower bracket assemblies, blocks, platforms, studs) to EU-DA and KO-DA for integration into vacuum vessel
- Fabrication in progress for remaining components

Diagnostics

Diagnostics — 3.1%

- PDR held for the sight tube (X-ray crystal spectroscopy survey)
- R&D underway for electron cyclotron emission diagnostic system, prototype calibration source, and THz detector system
- Detailed design and analysis activities carried out for upper port 9

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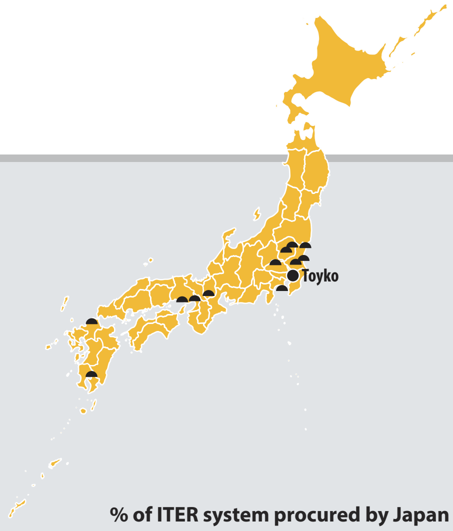
* Does not include Complementary Diagnostic Arrangements.

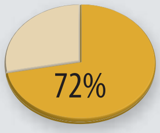
ITER JAPAN (JA-DA)

www.fusion.qst.go.jp/english/iter-e/iter.html

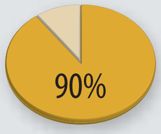


Procurement Arrangements*

Thirteen PAs signed since 2007 representing…



72% in number



…and 90% of the total value of JA in-kind contributions.

Over 800 design or fabrication contracts related to ITER procurement have been signed with industry since 2007.

Japanese procurement highlights in 2015

% of ITER system procured by Japan

Magnet Systems

Toroidal Field Conductor — 25%
- All conductor unit lengths completed in 2014

Toroidal Field Magnet Windings (9 out of 19) — 47%
- Double pancake prototype insulation and impregnation successfully performed
- Toroidal field coil series production underway

Toroidal Field Magnet Structures — 100%
- Material procurement for series production underway
- Coil structures series production underway
- Segments of the first inner case section successfully connected

Central Solenoid Conductor — 100%
- 20 conductors (four 613 m and sixteen 918 m) manufactured, corresponding to 40% of required material
- 16 unit lengths shipped to US-DA, cumulative (32%)

Heating & Current Drive Systems

ITER & Neutral Beam Test Facility (NBTF) High Voltage Bushing and Accelerator — 100% / 33%
- Manufacturing and assembly of HV bushing completed; HV test at each stage (240 kV) performed

Neutral Beam Power Supply System for ITER and NBTF — 59%
- Three DC generators out of five fabricated and shipped
- Transmission lines 1 and 2 fabricated and shipped
- Two other DC generators plus DC filter in progress
- Installation work initiated at NBTF

Electron Cyclotron Radio Frequency Power Sources (8 gyrotrons out of 24) — 33%
- Fabrication of four diamond windows and two superconducting coils completed
- Contracts awarded for two of eight gyrotrons
- Gyrotron FDR successfully held and closed

Electron Cyclotron Equatorial Launcher — 71%
- Millimetre wave mockup (based on poloidal steering launcher design) in testing

Remote Handling

Blanket Remote Handling System — 100%
- FDR held for first of three packages
- Contract awarded for package #1 (vehicle/manipulator, rail and rail support)

Divertor

Outer Target — 100%
- High heat flux testing of full-tungsten prototype plasma-facing units performed in RF-DA test facility
- Plasma-facing units successfully qualified

Tritium Plant

Atmosphere Detritiation System — 50%
- PA signed for Atmosphere Detritiation System (phase one, qualification test) in September
- Joint JA-DA/ITER Organization procurement activities are proceeding

Diagnostics

Diagnostics — 14.2%
- Construction of Advanced Diagnostics Building completed at the Japan Atomic Energy Agency (JAEA)
- Contract completed for the preliminary design of the edge Thomson scattering system, the poloidal polarimeter, the divertor impurity monitor and IR thermography
- Contract awarded for the manufacturing of mineral-insulated (MI) cable for micro fission chambers; MRR for MI cable held successfully
- PDR held for the poloidal polarimeter
- First elements of micro fission chambers manufactured

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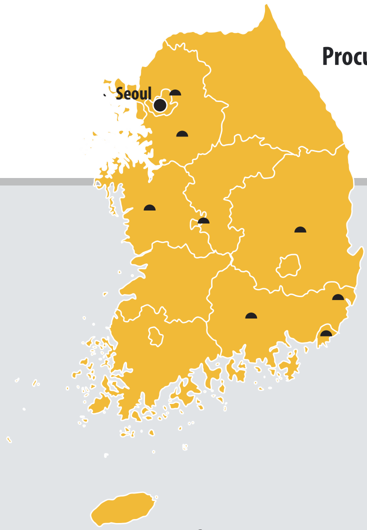
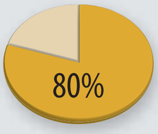
ITER KOREA (KO-DA)

www.iterkorea.org

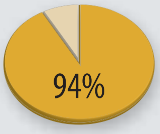


Procurement Arrangements*

Eight PAs signed since 2007 representing…



80% in number



...and 94% of the total value of KO in-kind contributions.

128 design or fabrication contracts related to ITER procurement have been signed with universities, laboratories and industry since 2007.

Korean procurement highlights in 2015

% of ITER system procured by the Korea

Vacuum Vessel

Main Vessel (2 of 9 segments) — *21.25%*
- Manufacturing underway on Sector 6 (first to be delivered) and Sector 1

Equatorial Ports — *100%*
- Ongoing manufacturing feasibility study for neutral beam ports

Lower Ports — *100%*
- Lower port stub extension manufacturing underway
- Lower port extension manufacturing launched

Blanket

Blanket Shield Block — *49.82%*
- Shield block qualification phase completed
- Manufacturing process qualification launched for first package
- Kick-off meeting held for first package

Power Systems

AC/DC Converters — *37.27%*
- AC/DC converter (CCU-1) and converter transformer (CCS, VS1) manufacturing completed
- Master controller Factory Acceptance Tests completed for correction coil power supply system

In-Vessel Coil Power Supply (busbars) — *100%*
- Concept design issues reviewed and improvements implemented

Magnet Systems

Toroidal Field Conductor — *20.18%*
- Delivery of all 27 conductor unit lengths to JA-DA (completed in 2014)

Thermal Shield

Vacuum Vessel Thermal Shield and Cryostat Thermal Shield — *100%*
- Vacuum vessel thermal shield fabrication ongoing; bending/forming of sectors 5 and 6 completed
- FDR held for thermal shield instrumentation
- Full-scale mockup of lower cryostat thermal shield (20° sector) completed
- Silver coating facility constructed

Assembly Tooling

Machine Assembly Tooling — *100%*
- Manufacturing readiness activities for first-delivery tools underway

Tritium Plant

Tritium Storage & Delivery — *82.09%*
- Storage and delivery system getter bed 1:1 mockup test ongoing
- Process feasibility verification test ongoing for storage and delivery unit
- Tritium inventory calorimetry, helium 3 recovery ongoing
- Modelling activities underway

Diagnostics

Diagnostics — *3.16%*
- PDRs held for vacuum ultra-violet (VUV) spectrometers and neutron activation system (NAS) transfer lines
- Prototype test of VUV spectrometer and NAS on KSTAR tokamak proceeding
- Contract awarded for final design technical support for KO-DA diagnostic procurement packages

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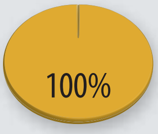
* Does not include Complementary Diagnostic Arrangements.

ITER RUSSIA (RF-DA)

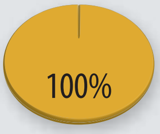
www.iterrf.ru

Procurement Arrangements*

Twelve PAs signed since 2007 representing…



100% in number



...and100% of the total value of RF in-kind contributions.

Over 800 design or fabrication contracts related to ITER procurement have been signed with industry since 2007.

Russian procurement highlights in 2015 — **% of ITER system procured by Russia**

Power Systems

Switching Network, Fast Discharge Units, DC Busbar and Instrumentation — *100%*
- Manufactured, tested and delivered first set of busbars and links to ITER
- Fabrication of other busbar system components ongoing (busbars, copper links, supports)
- Type testing of prototype components underway
- Series production documentation approved by IO
- Engineering analyses and R&D test reports issued
- Materials and components purchased for future production

Magnet Systems

Toroidal Field Conductor — *19.3%*
- All conductor unit lengths completed and delivered to EU-DA

Poloidal Field Conductor — *20%*
- Full scope of work completed in 2015; credit request submitted
- 11 cables delivered to EU-DA (5 for PF1 and 6 for PF6)
- 6 PF1 conductors delivered to RF-DA coil facility
- 2 PF6 conductors delivered to EU-DA coil facility
- Testing at SULTAN underway on conductor samples

Poloidal Field Magnet No.1 — *100%*
- 3D model updated according to new design
- Insulation qualification concluded including push-out test
- He inlet prequalification carried out
- Winding line commissioned though fabrication of first dummy pancake
- Successfully produced and tested several qualification samples (helium inlet, dummy conductor mockup, turn insulation)

Blanket

Blanket First Wall — *40%*
- Full-scale prototype design approved for enhance heat flux first wall panels; set of general assembly drawings agreed
- Mechanical system of attachment (first wall panel to blanket shield blocks) manufactured and tested
- New electrical connection strap designed and manufactured from CuCrZr; tested successfully
- Fabrication and testing of qualification semi-prototype beryllium first wall panel
- Material specification for the supply of beryllium blocks approved
- Tests carried out on first wall armour tiles in beryllium

Blanket Module Connections — *100%*
- Shield block/vacuum vessel electrical strap manufactured by electrical discharge machining; mechanical cyclic test and analysis performed
- Cyclic mechanical test of rectangular pads (reduced radius) performed
- Test program launched to verify robustness of ceramic coatings for key pad interfaces
- Quality plan approved

Divertor

Dome — *100%*
- Manufacturing design completed by contractors; prototype initiated
- Brazing technology optimized for dome divertor umbrella
- Control facility for the ultrasonic verification of reflecting targets (multi-layered connections) prepared; protocols developed for full-scale dome divertor models
- Quality assurance documentation approved

Plasma-Facing Component Tests — *100%*
- Qualification carried out for imitator plasma-facing units (dome divertor outer particle reflecting plate)
- Test facility manipulator redesigned; all mobile elements manufactured
- High Heat Flux Testing Procurement Arrangement updated with IO

Vacuum Vessel

Upper Ports — *100%*
- Manufacturer quality assurance procedures prepared; manufacturing design updated; manufacturing technologies developed
- Qualification and production tests carried out
- Nearly all base material procured for upper ports
- Manufacturing design updated for some upper port segments to meet requirements
- Inner shell (double wall section of port stub extension #12) fabricated

Port Plug Test Facility — *100%*
- Technical documentation updated

Diagnostics

Diagnostics — *17%*
- Diagnostic amendment signed for Upper Port Plug 7
- PDR held for divertor neutron flux monitor
- R&D progress on divertor neutron flux monitor, vertical neutron camera, charge exchange recombination spectroscopy, HFS reflectometer, H-alpha spectroscopy, neutral particle analyzer, divertor Thomson scattering and laser induced fluorescence

Heating & Current Drive Systems

Electron Cyclotron Radio Frequency Power Sources (8 gyrotrons out of 24) — *33%*
- Factory tests accomplished for gyrotron prototype
- 1 MW operation demonstrated for 1,000 seconds, exceeding requirements
- Gyrotron FDR successfully held

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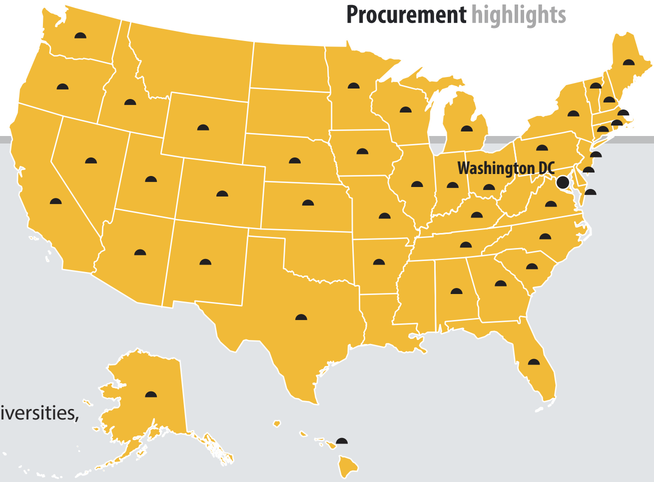
* Does not include Complementary Diagnostic Arrangements.

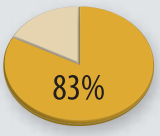
US ITER (US-DA)

www.usiter.org

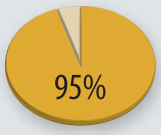


Procurement Arrangements*

Fifteen PAs signed since 2007 representing…



83% in number



...and 95% of the total value of US in-kind contributions.

The US has awarded over 500 design or fabrication contracts to US industry, universities, and national laboratories in 43 states plus the District of Columbia since 2007.

US procurement highlights in 2015 — **% of ITER system procured by the US**

Cooling Water Systems

Tokamak Cooling Water System — *100%*
- Delivered five cooling water drain tanks to ITER site
- IO contract in place for process, systems and captive piping drawings
- Framework contract awarded by IO for piping and fittings
- Resource-loaded schedule developed for completion of final design

Magnet Systems

Central Solenoid Modules, Structure and Assembly Tooling — *100%*
- Winding started on module 1
- Elements of structural support system (lower key blocks, tie plates) in fabrication
- Conducted MRR for heat treatment and turn insulation
- Completed MRR preparation meeting for stack and join, helium penetrations, joint and terminal prep
- Contract awarded for tie plate first articles, upper key block, load distribution plate, assembly platform, and lifting fixture
- FDR held for remaining assembly tooling fixtures
- 4K cold testing facility built for final testing of each module

Toroidal Field Conductor — *8%*
- Delivered three 760 m conductors to EU-DA winding facility
- Fabrication of one 100 m conductor by second integrator
- Completed fabrication of cables 3 and 4 (of 9)

Diagnostics

Port-Based Diagnostic Systems — *14%*
- Contract awarded for phase 1 of the motional stark effect diagnostic
- Contract awarded for manufacturing design studies for the diagnostic shield module

Heating & Current Drive Systems

Ion Cyclotron Transmission Lines — *88%*
- Contract awarded for DC breaks test article, tuning stub and drive mechanism test article
- PDR held for Radio Frequency Building high power transmission line (Review 4)
- Prototype radio frequency power source tested in factory at relevant power level > 1 hour

Electron Cyclotron Transmission Lines — *88%*
- Contract awarded for 4.2 m waveguide manufacturing process
- Technical package prepared for procurement of polarizer pair test article design

Fuel Cycle

Vacuum Auxiliary and Roughing Pump Stations — *100%*
- Testing completed on roots and screw prototype pumps
- Vacuum system piping arrangement signed with IO

Pellet Injection System — *100%*
- Began procurement of initial cask and piping design integration
- PDR held for pellet injection systems level
- PDR held for pellet injection flight tubes

Disruption Mitigation System — *100%*
- PDR held for disruption mitigation systems level

Tritium Plant

Tokamak Exhaust Processing System — *88%*
- Process study deliverables completed (part of Task Agreement)

Power Systems

Steady State Electrical Network — *75%*
- High voltage (HV) control and protection components, HV substation transformers, 22 kV switchgear, and earthing resistors delivered to ITER site
- Four substation transformers delivered for installation on site
- 6.6 kV switchgear delivered to EU-DA manufacturing site
- Contract awarded for reactive power compensators; 13 of 15 power systems contracts now signed

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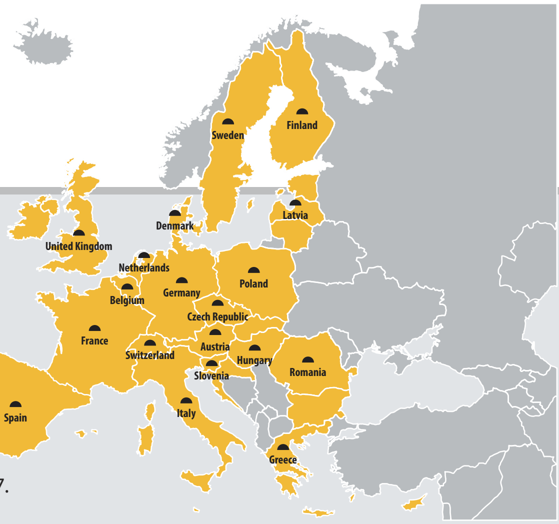
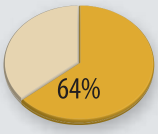
FUSION FOR ENERGY (EU-DA)

www.fusionforenergy.europa.eu

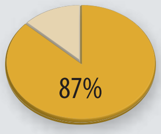


Procurement Arrangements*

Thirty-two PAs signed since 2007 representing…



64% in number



…and 87% of the total value of EU in-kind contributions.

The EU has awarded 498 design or fabrication contracts (88 in 2015) related to ITER procurement to universities, laboratories and industry since 2007.

EU procurement highlights in 2015 — **% of ITER system procured by the EU**

Buildings

Building Construction, Tokamak Pit Excavation and Drainage, Ground Support Structure, Seismic Isolation Pads — *100%*
- First pour of the Tokamak bioshield (B2) achieved successfully
- Started on upper basement level (B1) of the Diagnostic Building
- Assembly Building roof raised and installed
- Progress on Cryoplant, Site Service Building, Cleaning Facility, Radio Frequency Heating Building and technical galleries
- Contract signed for site infrastructure

Architect Engineer Services — *45%*
- Construction design approved for: Tokamak Complex up to level L2, Assembly Building, assembly cranes
- FDR started for building services

ITER Headquarters — *53.5%*
- Headquarters building completed in 2012

Magnet Systems

Toroidal Field Conductor — *20.18%*
- Fabrication completed of 26 conductor lengths (8 lengths manufactured in 2015) and 7 dummy lengths

Toroidal Field Magnet Windings (10 out of 19) — *53%*
- Series production ongoing: 41 double pancakes wound, 36 heat treated, 32 transferred to radial plates, 24 conductor turn insulated, 22 cover plates laser welded, 14 ground insulated, 12 impregnated double pancakes ready for stacking
- 36 radial plates completed
- Design of all main insertion tooling completed; main process qualification plan approved; welding, ultrasound inspection, and resin filling ongoing
- First 1:1 cross-section welding mockup of toroidal field coil straight leg successfully completed

Pre-Compression Rings — *100%*
- Qualification phase ongoing

Poloidal Field Conductor — *18%*
- Production of six conductor lengths and three dummy lengths completed

Poloidal Field Magnets No. 2-6 — *100%*
- On-site facility: contract signed for manufacturing; contract signed for impregnation and additional tooling
- On-site facility: 32% of tooling installed and commissioned
- Tooling and component qualification underway in China for PF6

Heating & Current Drive Systems

Power Supply Heating Neutral Beam — *35%*
- Contract signed for neutral beam acceleration grid power supply (AGPS) and ground related power supply (GRPS)
- Final design of HVD1 and MITICA bushing

Neutral Beam Test Facility (NBTF) Components — *64.7%*
- Delivery of SPIDER gas injection and vacuum plants to NBTF
- SPIDER high voltage deck accepted
- Final design of MITICA beam line components approved
- Installation of SPIDER vessel completed
- Manufacturing design of MITICA vessel approved
- Technical specifications for MITICA beam source and MITICA SF6 handling plant approved
- Service contract signed for NBTF structure

Neutral Beam Assembly, Testing, Active Compensation & Correction Coils — *100%*

Neutral Beam Source and High Voltage Bushing — *41%*

Neutral Beam Pressure Vessel, Magnetic Shielding — *100%*

Ion Cyclotron Antenna — *60%*
- Requirements for antenna design captured and reviewed
- Shut down dose rate analysis of antenna with new in-vessel configuration
- Brazing of Al to Ti tested for vacuum window

Electron Cyclotron Control System — *100%*
- Revision of requirements and definition of interfaces
- Fabrication and testing of prototype of ultra-fast protection system

Electron Cyclotron High Voltage Power Supply — *62%*
- Start of fabrication of power supplies (set 1)

Electron Cyclotron Upper Launchers — *76%*
- Design adaptation in progress to reflect changes in vacuum vessel interfaces
- Testing complete for diamond disk window prototype: disk qualified
- Contract signed for electron cyclotron component test facility gyrotron
- Framework contract awarded for cooling systems design support

Electron Cyclotron Radio Frequency Power Sources (6 gyrotrons out of 24) — *25%*
- Validation of the 1MW gyrotron design
- Delivery of 1MW prototype

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FUSION FOR ENERGY (EU-DA) – Continued

www.fusionforenergy.europa.eu

EU procurement highlights in 2015 | **% of ITER system procured by the EU**

Vacuum Vessel

Main Vessel (7 of 9 segments) — 80%
- Manufacturing mockups completed
- Completion of conceptual design (Sector 4)
- Sector 5: completion of manufacturing drawings; completion of manufacturing design for jigs and frames; first welding qualifications and welds; first manufacturing activities (hot forming)
- Filler welding material qualified
- First lot of forgings delivered

Divertor

Inner Vertical Targets — 100%
- Contracts signed for the pre-qualification of additional inner vertical target suppliers
- Contract signed for the procurement of alternative tungsten material grade

Cassette Body and Assembly — 100%
- Fabrication initiated on full-scale divertor cassette body prototypes following approval of pre-production documentation

In-Vessel Divertor Remote Handling Equipment — 100%

Divertor Rail — 100%

Blanket

Blanket First Wall — 47.4%
- Successful completion of three qualification first wall semi-prototypes by three selected contractors
- Successful pre-qualification of EU-DA for first wall procurement following completion of high heat flux tests
- Pre-manufacturing review completed; fabrication of first wall full-scale prototypes (three contracts) underway
- First high heat flux test campaign completed on irradiated first wall mockup
- Contract placed for beryllium tile repair technique study
- Contract signed on additive manufacturing (possible alternative first wall panel fabrication method)
- Contract signed for component high heat flux testing

Blanket Cooling Manifolds — 100%
- FDR held for blanket cooling manifolds

Remote Handling

In-vessel Divertor Remote Handling System — 100%
- Launch of preliminary design activities by contractor
- Completion of tests (phase 1) for divertor central cassette locking system

Cask and Plug Remote Handling System — 100%
- Cask and Plug Remote Handling Procurement Arrangement signed in June
- Framework contract evaluation completed

Neutral Beam Remote Handling System — 100%
- Framework contract signed; preparatory activities for preliminary design initiated
- R&D on pipe tooling completed

Common technologies — 100%
- R&D on rad-hard electronics for sensor signal conditioning and multiplexing completed
- Design of rad-hard digital mini-camera demonstrator completed, manufacturing started
- Cable length studies and 3D stereo vision studies completed

In Vessel Viewing System — 100%
- Framework contract signed; preparatory activities for preliminary design initiated

Power Systems

Steady State Electrical Network (SSEN) and Pulsed Power Electrical Network (PPEN): Detailed System Engineering Design — 100%
- Transformer pits realized on site and first four transformers installed
- Final design of main AC distribution approved

Engineering Design and Installation — 100%

Emergency Power Supply — 100%

SSEN Components — 25%

Fuel Cycle

Front End Cryo-Distribution: Warm Regeneration Lines — 100%
- Warm regeneration line components: functional and mechanical performance completed

Front End Cryo-Distribution: Front End Cryopump Distribution — 100%

Cryopumps, Torus (6) and Cryostat (2) — 100%
- Start of assembly for pre-production cryopump

Cryopumps, Neutral Beam — 100%

Leak Detection — 100%

Tritium Plant

Water Detritiation System — 100%
- Delivery and installation of six water detritiation system tanks

Hydrogen Isotope Separation System — 100%

Cryoplant

Cryoplant: LN2 Plant and Auxiliary Systems — 50%
- Final design completed for LN2 plant and auxiliary systems
- Factory Acceptance Testing on first batch of equipment

Diagnostics

Diagnostics — 25%
- System architecture, subsystem requirements and interfaces defined for most diagnostic systems
- First-of-series continuous external Rogowski coil components manufactured and successfully tested
- Promising results achieved in first mirror lifetime optimization
- In-vessel electrical wiring maps completed

Radioactive Materials

Waste Treatment and Storage — 100%

Radiological Protection — 100%
- Preliminary design completed for Tokamak radiological and environmental monitoring systems

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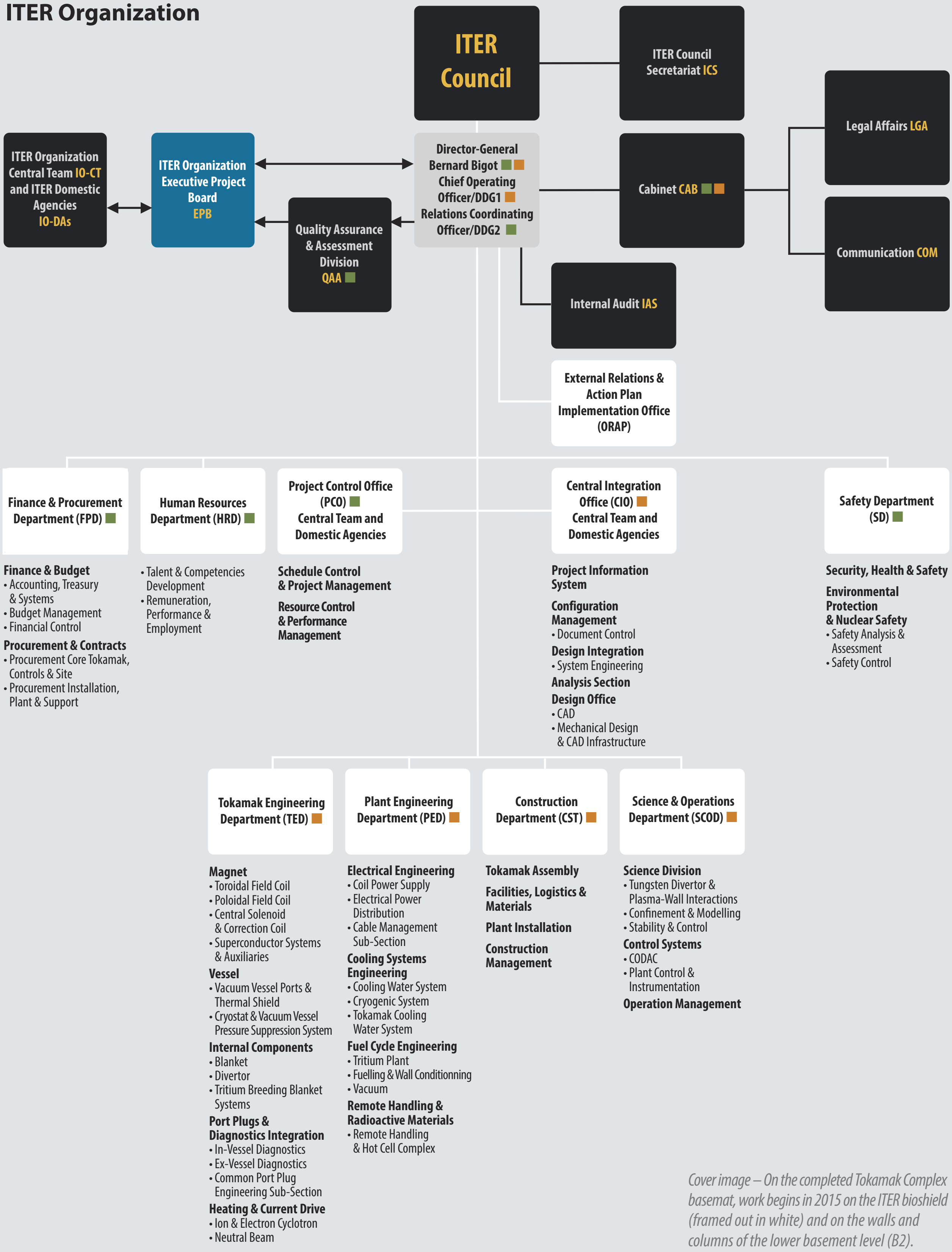
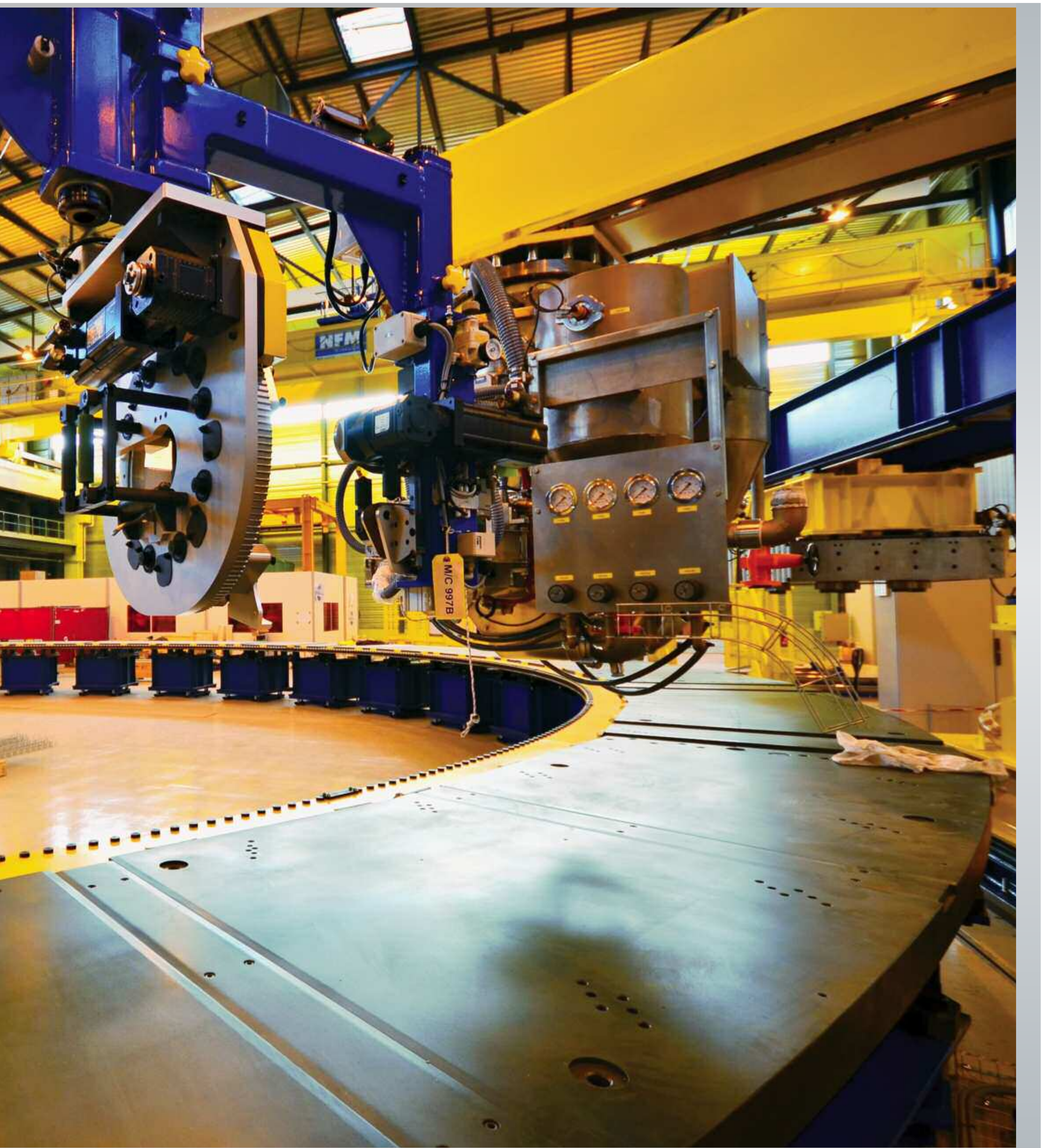
ITER Organization



Cover image – On the completed Tokamak Complex basemat, work begins in 2015 on the ITER bioshield (framed out in white) and on the walls and columns of the lower basement level (B2).

Late 2015, the first winding tooling is installed by European Domestic Agency contractors in the Poloidal Field Coils Winding Facility. Four of ITER's ring-shaped poloidal field magnets will be wound and assembled in this on-site facility.



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