ITER Organization 2008 Annual Report

contents

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energy

A huge global increase in energy use is inevitable.

Foreword from the Chair of the ITER Council

This second Annual Report describes the very considerable progress that has been made during the ITER Organization's first full year of operation. During 2008, the foundations of our international organization were greatly strengthened. All of the ITER Domestic Agencies are now up and running, and the ITER Organization is already reaping the benefits of their key contributions. They are the essential interface between the ITER Organization and its Members, and the cornerstone of the international collaboration that underwrites ITER.

Important work was carried out during the year that addressed all of the pending ITER design issues. It is absolutely critical for the future of the project that the design is optimized to deliver the project's goals with high confidence while keeping the cost to a minimum. The ITER Organization is taking the necessary time to do this, with the support of its advisory bodies—the Council's Management Advisory Committee and Science and Technology Advisory Committee, and the Director-General's Technical Advisory Group.

A very impressive platform, one kilometre long and 400 metres wide, is nearly finished on which the ITER facilities will be erected. Building this vast platform involved moving 2.5 million cubic metres of earth and rock—equivalent to the volume of the great pyramid of Cheops. It is needed because the ITER Tokamak will be twice as large as any previous fusion device. This scale will to provide the ITER Members and scientists from associated fusion programs with the opportunity to study fusion in power station conditions. Results from ITER will bring humanity much closer to the realization of fusion as a large-scale and affordable form of energy.

Starting an international organization from zero has been an enormous challenge. Laying down procedures for the efficient running and reporting of the organization; integrating new staff arriving monthly from the seven ITER Members; establishing the tools needed for scientific collaboration over long distances—all of this has been accomplished in a short time, and I think we can all feel proud of progress since the establishment of the ITER Organization in 2007.

With you, I look forward to the year to come.

Sir Chris Llewellyn Smith F.R.S.
Chair of the ITER Council

"Results from ITER will bring humanity much closer to the realization of fusion as a large-scale and affordable form of energy."

priority

There is an urgent need to seek cleaner ways of producing energy on a large scale.

Foreword from the Director-General

2008 was an important and productive year for the ITER Organization. Following our inception last October, we concentrated this year on laying the groundwork for the major undertaking that lies ahead. The first full year of activity for the ITER Organization was very full indeed.

After completing a thorough design review in 2007, all departments worked toward the revision of the technical specifications for the ITER machine; this revised technical baseline was submitted to the ITER Council and approved. The Council also agreed to use the proposed Overall Project Schedule for planning purposes until the resource-loaded and optimized schedule is fully developed. Based on these technical and schedule baselines, new project resource estimates for the Construction Phase were prepared and submitted. Work will continue into 2009 to finalize these baselines which are a critical part of project management.

The recruitment of over one hundred qualified staff gave much impetus to our young organization. Management processes improved throughout the year; and where adjustments were necessary, solutions were proposed and implemented. Taking possession of the first building on the ITER site in November—the temporary Headquarters building—was a very rewarding milestone.

The building site in Cadarache, southern France, was transformed in twelve months from roughly-cleared land to a construction platform of 42 hectares that is nearly completed. Two other important steps on the road to building ITER were accomplished during the year: the construction permit for the ITER installation was granted, and the safety files were submitted to the French authorities so as to formally initiate the nuclear licensing process.

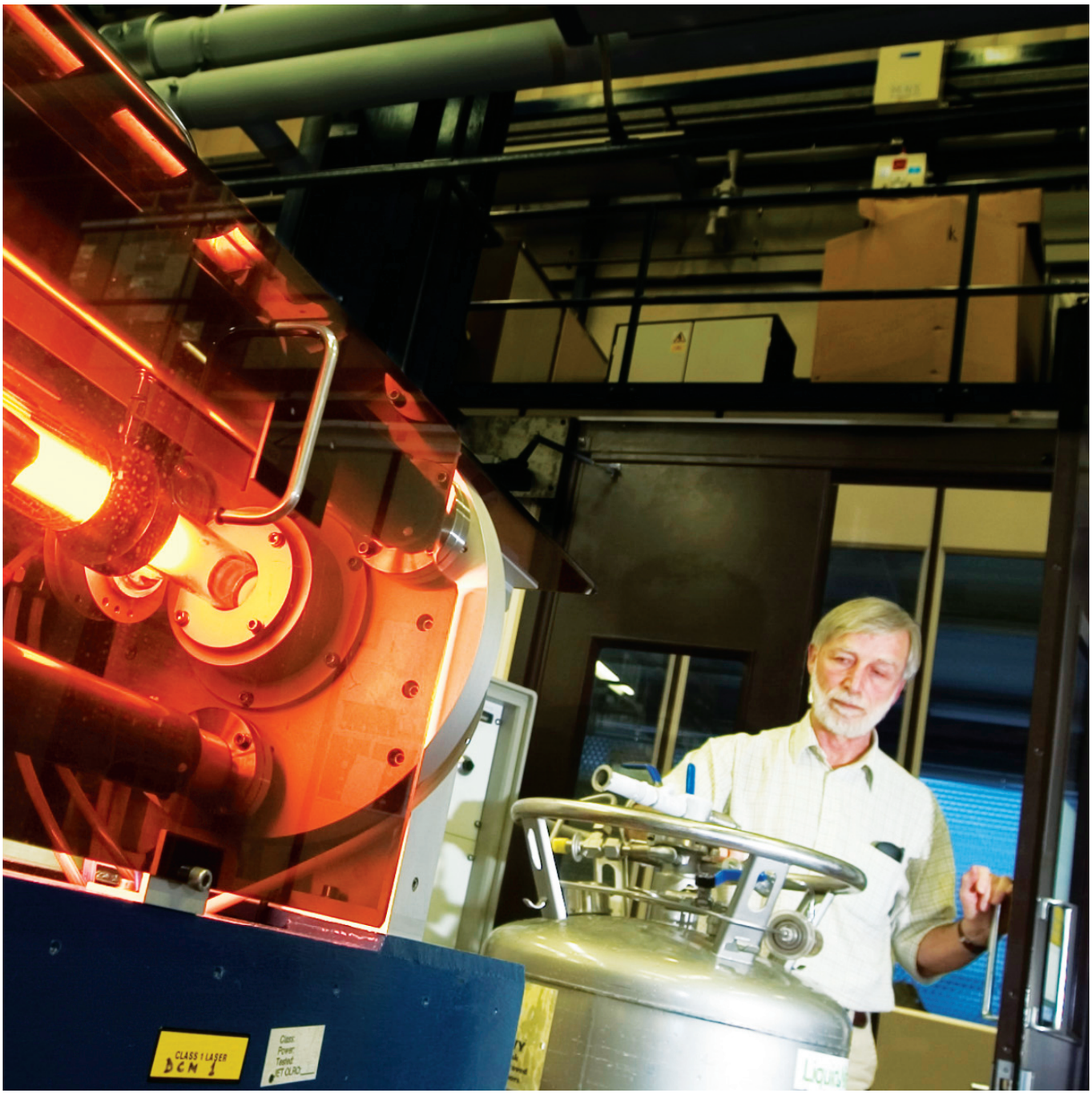
The procurement of components gathered momentum in 2008. Ten Procurement Arrangements were signed with the Domestic Agencies for major systems including the vacuum vessel, magnets, and buildings. These Procurement Arrangements represent an important benchmark for progress towards the industrialization of the project.

I would like to conclude by thanking the governments of the ITER Members for their belief in ITER which has been the driving force behind all of our work. I also express my appreciation to the Domestic Agencies and the ITER Council advisory bodies—the Management Advisory Committee and the Science and Technology Advisory Committee—for all they have done to define the path of ITER.

Kaname Ikeda
Cadarache, April 2009

"The building site in Cadarache was transformed in twelve months from roughly-cleared land to a construction platform of 42 hectares that is nearly completed."

fusion



Fusion offers important advantages: no carbon emissions, no air pollution, unlimited fuel, intrinsically safe.

Executive Summary

Organization

In 2008, important steps toward consolidating our international organization were taken. The Domestic Agency for China was finally established in October, bringing all the Domestic Agencies into place. Staff arrived in increasing numbers from all the Members, and administrative procedures were set into place for the efficient running and reporting of the project. It was the first full year of activity for the ITER Organization; work toward arresting the technical scope, schedule and cost of the project remained the top priority.

The second meeting of the ITER Council was held in Aomori, Japan on 17–18 June, and the third meeting in Cadarache, France, on 19–20 November. Meetings of the ITER Council advisory bodies—the Science and Technology Advisory Committee (STAC) and the Management Advisory Committee (MAC)—took place prior to each ITER Council meeting. Sir Chris Llewellyn Smith and Academician Evgeny Velikhov were re-elected as Chair and Vice-Chair of the ITER Council, to serve until the end of the calendar year 2009.

An ITER Council Working Group on Export Control, Peaceful Uses and Non-Proliferation was established during the year to create awareness in the ITER Organization and the Domestic Agencies on the subject of export control. The working group met twice to examine issues relating to the control of sensitive information.

In January, a Partnership Arrangement was signed with the Principality of Monaco, establishing a contribution to the ITER project of 5.5 M€ over ten years. This sum will be used to set up five Postdoctoral Fellowships every two years and to establish an annual international conference on ITER-related research. Cooperation Agreements were also signed with the European Organization for Nuclear Research (CERN) and the International Atomic Energy Agency (IAEA) during 2008 providing frameworks for collaboration in research, technology and administration.

At the tenth meeting of the International Tokamak Physics Activity (ITPA) Coordinating Committee in June/July, it was agreed that the ITPA would henceforth be operated under the auspices of the ITER Organization, facilitating closer collaboration between the physics community and the ITER Organization.

Construction Progress

Site clearing was completed in 2008. Levelling work on the ITER platform began in March under the management of Agence ITER France. This work proceeded at an impressive rate, despite an unseasonably rainy spring and autumn. Modifications to roads, bridges and underpasses along the ITER Itinerary are ongoing as part of the contribution of the region in preparation for the transport of the largest components of the ITER machine that will arrive by sea.

The Construction Permit ("Permis de Construire") was granted in April by the local authority. The Pre-Architect (Pre-AE) contract for the definition of preliminary design of all buildings and site infrastructure was awarded in May.

In November, the ITER Headquarters building was completed, and approximately 200 staff made the move to the ITER site. A Visitor Centre was also erected above the platform during the year. Approximately 4000 visits were managed by the ITER Organization and Agence ITER France; this number is expected to triple in 2009.

The design of the permanent Headquarters of the ITER Organization progressed rapidly during the year. The Architectural Drawings were completed and the calls for tender for the construction of the building are planned for 2009.

Licensing

Concerning nuclear licensing, the safety files including the Preliminary Safety Report RPrS were submitted to the French authorities in January. Recommendations for improvements were received in return in the autumn, and an updated version of the safety files is under preparation. As part of the licensing process, a Public Inquiry will take place following the submission of the updated files.

ITER Project Baseline

Following the recommendations made by the STAC in 2007, the ITER Organization and the Domestic Agencies, supported by the world's fusion community, worked tirelessly in 2008 to resolve major design issues. A proposal for a new Project Specification detailing ITER's scientific goals and technical parameters was adopted by the ITER Council in June, with important implications for the scope, schedule and cost of the project. Among the improvements adopted in the new technical baseline are: additional coils to improve the control of Edge Localized Modes (ELMs) and the vertical stability of the plasma, and a new design for the Hot Cell. The ITER Council also agreed, for planning purposes, to the revised Overall Project Schedule with a target date of 2018 for First Plasma.

Work continued during the year on the ITER Research Plan, the baseline document describing the principal physics activities for the Construction Phase, as well as the experimental physics program planned for the first ten years of ITER operation. The Test Blanket Module (TBM) program will be the first technological element included in the ITER Research Plan. This program will test concepts for achieving self-sufficiency in tritium supply for future fusion power plants. Progress was made toward a more explicit definition of ITER plasma scenarios. The Q=10 reference scenario was proven attainable, and the 17 MA 'assessed scenario' was essentially completed.

Overall Project Cost and a Project Plan and Resource Estimates documentation was developed and an Integrated Project Schedule established for planning purposes. The Resource Estimates are based on the Work Breakdown Structure Level 3, and take design changes into account excepting remaining open design issues such as ELM coil specification. In June, the ITER Council recommended an independent assessment of the Organization's costs as the next step toward bringing the new design and schedule to reality. The Briscoe Panel, formed with representatives from each Member, worked with the resource estimates, and in September presented its recommendations for improvements to the cost management systems to the MAC. The Panel recommended a more integrated approach involving stronger cooperation between the ITER Organization and the Domestic Agencies. This higher level of integration is a crucial step for moving the project forward, streamlining management and containing costs. The third meeting of the ITER Council gave its support to the Briscoe Panel recommendations, and work will continue into 2009.

Procurement Arrangements

The signing of ten Procurement Arrangements, including the first Building Procurement Arrangement with the European Domestic Agency, contributed important momentum to the year. However, not all Procurement Arrangement schedules could be met in 2008 due to Design Change Requests for the new technical baseline; this delay needs to be recovered in 2009.

The creation of Integrated Product Teams (IPT) was proposed to the ITER Council in November 2008 and approved. These teams are intended to establish a closer working relationship between the ITER Organization and the Domestic Agencies by assigning roles, responsibilities, authority, and accountability in order to make in-kind contributions from Members a more efficient process. Three pilot IPT teams were created for the blanket, the vacuum vessel and the power supply soon after this approval. Defining the roles and responsibilities of the Domestic Agencies and the ITER Organization as we move forward to the industrialization of the project will be crucially important.

Scientific R&D

Important research and development work in support of ITER went on around the globe in 2008. Key technologies successfully tested for the Tokamak included: the poloidal field coil insert; carbon-fibre composite monoblock and tungsten monoblock mockups; first wall qualification mockups; and a divertor qualification prototype.

Both Korean and Russian toroidal field conductor qualification samples were accepted.

Staffing

Staff numbers increased in 2008, rising from 193 to 300 staff members by the end of the year (see Staffing Tables). The ITER Organization completed the process of signing five-year employment contracts for more than 200 directly-employed staff. Annual staff appraisals were instituted for ITER staff, and the first appraisal exercise completed. The first five-member Staff Committee was elected in 2008. Also, five candidates were selected in November for the Monaco-ITER Postdoctoral Fellowships.

Finance

The final total of commitment appropriations for 2008 was 104.645 M€, against which commitments of 103.736 M€ were made; leaving a balance of unused appropriations of 0.909 M€ to be carried forward to 2009. The payment appropriations for 2008 were set at 114.889 M€, against which 81.762 M€ were paid; leaving a balance of 33.127 M€ of which 33.027 M€ has been transferred to the Special Account (see Financial Tables).

Concerning auditing, within the ITER Organization the Office of Audit Service (OAS) became fully operational during the year. The external Financial Audit Board, comprised of independent assessors from the seven Members of the ITER Organization, held two meetings in Cadarache, and conducted its first on-site audit in April.

Management Systems

The ITER Organization made big strides in 2008 in setting up tools to improve project management, and facilitate collaborative work inside the ITER Organization and with the Domestic Agencies. Internal communications architecture was chosen for ITER and rolled out during the year. File transfer performance over the ITER Collaborative Network was improved and now functions seamlessly. A new CAD database tool, ENOVIA, was launched in a pilot program in the US Domestic Agency and is a first step to a truly global design office. Planned rollout to all Domestic Agencies is a priority for the coming year.

Management software was implemented for the administration of the project that includes tools for budget, procurement, finance and human resources. These tools will significantly facilitate day-to-day management in our Organization, and improve reporting capabilities and traceability.

International School

The International School of Manosque was developed over the year thanks to the support of the PACA region. 211 students were enrolled in September 2008 of which half were children of ITER staff. Classes are taught in a combination of French and six foreign languages. Work is underway to deliver the first part of the new school building: the primary school, administrative offices, restaurant and underground parking facility will be ready in September 2009, while the junior and senior high school will be completed by September 2010.

collaboration

A global collaboration has been formed to test the feasibility of fusion.

2008 Highlights

Project Office (PRO)

The Project Office has the responsibility for the management of technical, schedule and cost baselines for the ITER project. It worked throughout the year to develop baselines for ITER construction in accordance with the baseline structures approved by the ITER Council. The Office worked closely with the departments and Domestic Agencies to conclude Procurement Arrangements and to improve management systems for project execution.

The technical baseline was the focus of important activity in 2008. The Office organized an extensive design review to solve thirteen priority issues identified by the STAC in 2007. Concrete proposals for design improvements were formulated and submitted to the STAC in April. The revised technical baseline design including these proposals received the STAC's full endorsement at its meeting in May. A Project Specification document was submitted to the ITER Council in June, and approved as the top-level technical baseline.

Workshops were organized with the Domestic Agencies to analyze the procurement schedule and its implications for the project. Based on this, the Office was able to develop an Overall Project Schedule that was approved by the ITER Council in June as the top-level schedule baseline. This schedule maintained the reference date of 2018 for the First Plasma, which is a realistic but aggressive deadline.

Concerning the cost baseline, Overall Project Cost and Project Plan and Resource Estimates documents were drafted and reported to the MAC meeting in May as the top-level cost and management baselines. During the year, the ITER Organization estimates were subjected to an independent review known as the Briscoe Panel. The Panel reviewed ITER resources—including staff, infrastructure and contracted services—as well as the current estimations for the additional direct investment costs due to priority-issue design changes, improvements to procurement packages, and additional spares.

In preparation for this review, extensive discussions were carried out with the Domestic Agencies regarding cost management and containment. An action plan was drawn up for the estimation of additional direct investment cost and possible cost-reduction measures such as standardization, design improvement, procurement process optimization and the simplification of procurement sharing in view of reducing interfaces between the ITER Organization and the Domestic Agencies.

Following the signature of the first two Procurement Arrangements in 2007, procurement work continued to be a major focus for the Project Office in 2008. Ten Procurement Arrangements were signed over the year; a total that fell below the projected 26. The Project Office implemented two important measures to improve the design and procurement process. First, the concept of Integrated Product Teams was proposed and accepted by the ITER Council, and three pilot teams for the blanket, the vacuum vessel, and the power supply were launched soon after this approval in November 2008. These product teams are intended to improve the collaborative work between the ITER Organization and the Domestic Agencies, and speed up the procurement process for the packages having complex interfaces and procured by multiple Domestic Agencies.

Second, the management structure within the Project Office was reorganized to support the work of the Integrated Product Teams and to meet the changing and expanding project needs. The new management structure effective in November includes three divisions for project management, technical integration, and nuclear safety and environment; and two sections for external coordination and operations. The new structure will give priority to finalizing the design and to Procurement Arrangements in order to maintain the project schedule and to improve and strengthen project management.

Concerning nuclear safety and environment, the Project Office developed the DAC safety file (Décret d'Autorisation de Création) including the preliminary safety report (RPrS) and supporting documents. The ITER Organization submitted this file to the safety authority

in January 2008 and received a first response in autumn listing the improvements required for the files to be acceptable for examination. The Project Office is now updating the safety file for resubmission in 2010.

Initial RAMI analysis (Reliability Availability Maintainability & Inspectability) was carried out during the year for major systems to ensure that RAMI and operational requirements had been integrated into the requirement documents.

An industrial delegation from Kazakhstan visited ITER in December to discuss a possible contribution to the project. The Project Office helped identify possible areas of contribution relevant to Kazakhstan's expertise, and negotiations for possible accession to membership in the ITER project will continue in 2009. Other forward-looking discussions continued for the inclusion of the Test Blanket Module program to the ITER project.

Department for Tokamak (TKM)

Following last year's extensive design review, the Department for Tokamak concentrated on the definition of a new technical baseline in 2008. The STAC recommendations of particular concern for the Department were: Edge Localized Mode (ELM) mitigation and vertical stability; asymmetric loads on the vacuum vessel; and plasma shaping-flux-internal inductance control. The Department initiated studies that resulted in proposals being made in April to the STAC which gave its overall support.

ELM mitigation presented the Department with the greatest challenge from a design, cost and schedule standpoint. Critical requirements included reliability over the 20-year Operation Phase of ITER and/or the accommodation of remote-handling replacement equipment. The basic ELM coil configuration design has been developed and is being incorporated into the vacuum vessel models.

Important design review meetings were held with the Domestic Agencies for the blanket, the vacuum vessel, and the divertor to take the STAC recommendations into account. Work toward the final design of the vacuum vessel was a top priority. The design of this critical component has far-reaching effects due to its many interfaces with surrounding systems. A series of meetings was held to address the final design of the vacuum vessel and vacuum vessel interfaces. This effort has resulted in the resolution of all but a few issues. The important issues remaining include blanket loads on the vacuum vessel, neutron shielding, ELM and vertical stability coils, and blanket manifolds. Each of these issues is currently being addressed.

Finalizing the design of the Tokamak components was an important and necessary step to generating Procurement Arrangements—a major requirement in moving toward the industrialization of the project. Nine important Procurement Arrangements were signed in 2008: Main Vacuum Vessel and Ports with Korea; Toroidal Field Magnet Windings and Magnet Structures with Japan; Toroidal Field Conductor with Russia, Korea, and China; Toroidal Field Winding with Europe; and Poloidal Field Conductor with China. Procurement Arrangements will continue to be a priority for our Department in 2009. Kick-off meetings for blanket and vacuum vessel Integrated Product Teams were held at the end of the year. These teams were formed to increase the efficiency of the procurement process.

Several critical technologies for the Tokamak were successfully tested in 2008. In Japan, the poloidal field coil insert exceeded the most optimistic expectations. The carbon-fibre composite monoblock and the tungsten monoblock mockups tested up to three times the number of cycles at design heat load. All three Domestic Agencies involved in the procurement of the divertor—US, Russia, and Japan—have delivered the required qualification prototypes, which have been successfully tested in St Petersburg, Russia. In the United States, the first campaign of thermal fatigue testing on first wall qualification mockups supplied by Europe and the US was successfully completed. Both Korean and Russian toroidal field conductor qualification samples were accepted.

Assembly and Remote Handling activities for the year focused on supporting the designs and related procurement activities of critical path systems like the vacuum vessel and magnets. Design support of in-vessel systems (blanket, divertor and in-vessel coils) was also an important activity, because assembly and remote handling considerations greatly influence the designs.

During the second half of 2008, the Department looked at alternative vacuum vessel and blanket designs to determine if there were cost/risk/schedule advantages for the project. Two alternative concepts were developed and assessed in October, and the decision was made not to change the current vacuum vessel baseline, but backup concepts would continue to be pursued. Alternative concept development will continue through 2008 and into 2009.

Department for Codac & IT, Heating and Current Drive, Diagnostics (CHD)

In 2008, an integrated installation and commissioning plan was completed based on the 2007 recommendations from the STAC. The plan concluded that Heating, Current Drive, and Diagnostic systems can be ready for the First Plasma target date of July 2018.

In Diagnostics, the new baseline for diagnostic systems was endorsed into the existing baseline with virtually no impact in terms of cost or cost sharing. The baseline was later extended to include dedicated systems for the measurement of erosion, dust and tritium retention. The interfaces of diagnostic systems with the vacuum vessel were fully defined and documented in preparation for the extensive review of the vacuum vessel and finalization of procurement. The design for a generic diagnostic upper port structure significantly progressed in 2008. Also, R&D contracts were placed on several key topics including prototyping critical parts of the port plugs and diagnostic first mirrors.

In the area of Heating and Current Drive, the baseline requirement of 73 MW of heating power for ITER was endorsed by the STAC. The Neutral Beam Test Facility, the second ion cyclotron antenna, and the revision of the ion cyclotron power supply and electron cyclotron system were also among the list of must-do tasks.

Progress was made in the detailed design for the diagnostic neutral beam in 2008. Optimization calculations permitted a reduction in the length of the diagnostics beam line by more than half a metre.

Detailed design work for the beam source was carried out, and neutral beam risk was assessed. Work continued throughout the year to finalize the technical specifications for the Diagnostics Neutral Beam Power Supply Procurement Arrangement which will be signed in 2009. The 170 GHz Gyrotrons used for heating the plasma reached a testing milestone of hundreds-of-second-long pulses at 1MW power. The European Domestic Agency also tested their 2MW Gyrotron for short pulses.

In response to the increase of IT network users on site from 300 to 500 in 2008, the IT team was enlarged through a long-term support contract that externalizes the majority of IT services within the ITER Organization. The average reaction time on critical IT problems was kept below one day. The ITER network was extended to the new Headquarters building which is the first on the new site. IT provided network, data and server access in time and equipped an all-new server room with modern video conferencing equipment. The data backup strategy was extended to include storage of all critical ITER data at a remote site. An agreement with the European Domestic Agency, Fusion for Energy, was reached to host a second backup server and storage disks. Each night an incremental backup of critical ITER data is performed in Barcelona.

After passing a conceptual design review for the ITER CODAC system (Control, Data Access and Communication) in 2007, work in 2008 focused on transforming the conceptual design into an engineering design. A CODAC group was formed on the ITER site that currently consists of 12 staff. The primary focus is to standardize both the development process as well as

hardware and software components for instrumentation and control. Given the large number of plant systems, the current estimate for components is 165, provided in kind by the seven ITER Members. This coordination represents one of the largest challenges of the project.

The CODAC group also focused on building a Plant System Profile database which will evolve into a complete profile of plant systems, including detailed description of signals and behaviour. The group worked toward finalizing a basic Plant System Host prototype as proof-of-concept for plant system integration and self description. A careful selection process was managed to decide on the major suppliers of Programmable Logic Controller equipment. The Plant System Control Design Handbook (PCDH) was edited and released and will be part of all Procurement Arrangements for in-kind procurements involving electronic instrumentation and control.

Civil Construction and Site Support Office (CCS)

Site preparations continued in 2008 under the management of Agence ITER France, including platform levelling, temporary and permanent access roads, and the establishment of contractor areas and temporary construction offices. Site work to evacuate 2.5 million cubic metres of rock and soil commenced in March 2008, and is expected to take one year.

Updated and additional information was submitted to the regulatory authorities for the Building Permit (Permis de Construire) request filed with the town of Saint-Paul-lez-Durance. In an important milestone for the project, the final Building Permit was awarded in April.

In 2008, the CCS Office placed the Pre-Architect/Engineering (Pre-AE) contract for the definition and preliminary design of all buildings and site infrastructure. The process took seven months, including an exhaustive series of assessments and interviews, before the final decision to award the contract was made. The development of the necessary project documentation as well as a number of Building Procurement Arrangements will be greatly facilitated by this contract.

An Additional Site Investigation contract was signed for the exploration into sub-soil conditions on the ITER platform. The results of these studies will be critical to the design of the buildings. An engineering design study contract for the Tokamak Seismic Isolation System was also awarded during 2008.

Progress was made in the definition and finalization of procedures and requirements for the several thousand interface control documents relating to site and buildings, providing a clear roadmap for future work. The CCS Office 'froze' the site and building layouts mid-year. System Requirement Documents, the first draft of all Design Description Documents, and over 500 drawings required for the definition of the preliminary design of all of the site buildings and infrastructure were completed by December.

Particular attention was paid to cost-saving measures in the design of the buildings. Workshops in value engineering were held that included outside experts in nuclear building design, construction, and heavy lifting industries. The CCS Office worked closely with Fusion for Energy to implement the conclusions of these workshops. Overall, the building footprint will be smaller than originally foreseen in the Project Baseline, minimizing cost without reducing functionality. Also, the decision was made to redesign the Poloidal Field Coil Winding Building as a steel rather than concrete structure, resulting in significant cost reduction and an improved construction schedule. Cost estimates for all buildings and site infrastructure were prepared by the end of the year.

A second important milestone for the CCS Office was the signature in November of the first Building Procurement Arrangement with the European Domestic Agency for the Poloidal Field Coil Winding Building. This Procurement Arrangement paves the way for commencing the detailed design, procurement and construction of the first building on the ITER platform.

Department for Central Engineering and Plant Support (CEP)

The CEP Department worked toward detailed resource estimates for the construction phase of the project during the year, with considerable attention to cost cutting. Division Heads were named for the Plant Engineering and Fuel Cycle divisions, completing the department's management structure.

In the Plant Engineering division, two design changes for the Cooling Water System were proposed and incorporated into the new baseline, improving overall system safety and reducing installation and operational costs. Work progressed toward the Tokamak Cooling Water System Procurement Arrangement with assistance from the US Domestic Agency. Initial process flow diagrams were prepared for this system. 3D models and layout of the cryoplant building were completed and transferred to the CCS Department for the finalization of building layout.

Studies for the optimization and design of the Hot Cell facility early in the year resulted in a recommendation to the STAC for Hot Cell Option A that was accepted. Work for the Hot Cell began in June, with expert advice from the Korean Domestic Agency. The purpose of the Hot Cell facility is to support overall ITER operation and maintenance, and for this reason a study was initiated with industry to review the reliability and maintainability of the Hot Cell facility. The initial layout of the radwaste facility for low-level Type A waste was completed, and a new estimate for low-level Type B waste was performed. This estimate was used to develop the conceptual design of the full chain processing system for the Hot Cell facility basement.

Final System Requirements drafts were completed for the Pellet Injection system, the Gas Injection system, and the Glow Discharge Cleaning. The ITER Vacuum Handbook was formally issued in December following an independent review.

Discussions on the Tokamak Exhaust Processing system resulted in a revised Process Flow Diagram. The Tritium Plant modelling effort was reviewed in order to achieve a complete tritium cycle system model to be used for design, simulation and ultimately training of operators. Also, a decision to relocate the fast discharge resistors from the Diagnostics building to a new steel framed building was made, resulting in a smaller Diagnostics building and significant cost savings to the project.

The design of the Steady State Electrical Power Network was substantially reviewed by the Electrical Engineering division and a new concept for electric power distribution was adopted. The main advantage of the new solution is that it better accommodates variation in the number of power demands by electrical consumers, while having no impact on cost. The RAMI analysis for this system was also completed.

During the year, the Design Office was responsible for managing the resources of industrial participants through service contracts. At the year end 2008, there were approximately 70 Computer-Aided Design (CAD) specialists involved in developing the mechanical, plant and configuration designs, as well as 30 engineers. Five Task Agreements relating to CAD and engineering resources were signed with the Domestic Agencies. As many as 500 CAD Data Export Tasks were performed with the Domestic Agencies. An important tool for CAD collaboration—the ENOVIA LCA database—was implemented for testing at the end of the year at the US Domestic Agency. This database is an important tool for CAD collaboration and Integrated Product Teams, enabling designers located in remote locations to fully share the ITER Organization CAD database. Roll-out to all Domestic Agencies is a priority for the Design Office.

Department of Safety and Security (SAS)

In the first month of 2008, the Safety and Security Department formally submitted the DAC nuclear licensing files ("Décret d'Autorisation de Création") to the French authorities, requesting the legal creation of the ITER installation. These files contained 14 reports including the Preliminary Safety Report (RPrS) and an

Impact Study. This formal submission was followed by a series of meetings with the Nuclear Safety Authority (ASN) in France to review the files, and to discuss operating limits and conditions for the ITER facility. Further detail was requested for the RPrS report, so that the level of information corresponds to the "detailed design" stage of the facility; an implementation plan was launched for updating RPrS and the 13 other files of the DAC. In particular, a three-volume Accident Analysis Report has been completed presenting computational analysis of event scenarios. This report demonstrated that potential consequences were well within the requirements of the General Safety Objectives and will be provided as complementary files to the safety regulator.

A working group on Safety and Quality Assurance was successfully launched involving the ITER Organization and the Domestic Agencies. This working group met four times in 2008, and was an efficient tool to keep the Members abreast of the licensing process, the content of the DAC files, and the ITER Quality Assurance program. In addition, delegations from the SAS Department travelled to three Domestic Agencies in order to further common understanding on quality issues. Six Domestic Agencies were able to complete the approval process for their Quality Assurance programs during the year, qualifying them for upcoming calls for tender.

The status of the ITER project was presented to the Cadarache Local Information Commission (CLI), and in November a specific CLI was created for ITER. Preparations continued for the Public Inquiry that will take place after the new DAC submission as part of ITER's licensing process.

The SAS Department successfully prepared and implemented safety and security arrangements for the move of 200 ITER staff to the new ITER Headquarters building in November. This included drafting internal regulations, preparing the security services contract, and organizing the transfer with Agence ITER France. A safety training program was implemented for all ITER staff.

Department for Fusion Science and Technology (FST)

During 2008, a detailed Physics Work Program was defined for 2009–2011 that required significant resources from the Members' fusion communities. Development of the ITER Research Plan (IRP) continued with emphasis on the exploration of operational scenarios required for the initial non-active phase of ITER, development of the agreed strategy for plasma-facing components, and elaboration of the experimental program for Deuterium-Tritium operation. This document will guide the preparations of the ITER experimental physics program and will be regularly updated. The FST Department conducted reviews on poloidal field control, power and particle exhaust strategy, and the test blanket module program pursuant to the recommendations of the STAC, and a revised Project Specification was submitted and approved by the ITER Council in June. Further progress was made regarding the ITER Baseline Documentation with the preparation of an updated Plasma Performance Assessment.

The FST Department was actively involved in the analysis of the Q=10 reference scenario. Due to progress in the performance capability of the poloidal field coil conductors, an improved vertical stabilization capability, and increases in the allowed separation forces within the central solenoid, the parameter range required for the Q=10 reference scenario was proven attainable. Progress was also made in the exploration of possible operating scenarios for 17MA. The redefinition of a 15MA reference scenario and a 17MA 'assessed scenario' were essentially completed, though some outstanding R&D issues were identified in relation to the plasma shut-down phase of the discharge. Development of detailed specifications for ITER plasma scenarios continued with the aim of providing a quantitative basis for the design of ITER systems such as magnets, power supplies, and the cryoplant.

Important work was carried out in the Department to develop the physics basis for the in-vessel coil

systems foreseen for vertical stabilization and shape control. The use of in-vessel coils, originally proposed for Edge Localized Mode (ELM) suppression was extended to substantially improve vertical position control, leading to converged specification on voltage and current requirements. Shape control optimization continued, with indications that limited changes in poloidal field coil specifications could provide an acceptable expansion of operational space. The FST Department was centrally involved in physics studies supporting the development of ELM mitigation by both Resonant Magnetic Perturbation coils and pellet pacemaking, and an R&D plan for ELM mitigation was developed in collaboration with the fusion community.

Following recommendations made by the STAC, a physics R&D plan for the study of plasmas with Tungsten plasma-facing components was developed in support of the divertor armour strategy. The Department was centrally involved in work to revise heat load specifications for plasma facing components and in the analysis of maximum electromagnetic loads associated with disruptions and Vertical Displacement Events. The revised heat load specifications will provide the physics basis for the ongoing detailed design work on the first wall, while the analysis of electromagnetic loads has allowed the design of the vacuum vessel supports to be finalized. Detailed modelling of divertor and edge plasmas supported the development of a revised design for the divertor target profile.

Development of the Test Blanket Module (TBM) program continued throughout the year, and considerable progress was made toward a technical and organizational framework for the TBM program. The first version of the 2008–2018 work plan for the program was drafted, and an implementation framework proposed in November was endorsed by the ITER Council. This includes the establishment of a TBM Program Committee which will advise the ITER Council on matters relating to the implementation of the TBM program.

The Department was represented at plasma physics-related conferences and activities at home and abroad in 2008. ITER research objectives were discussed with senior members of the fusion community at the June meeting of the International Tokamak Physics Activity (ITPA) Coordinating Committee in Aix-en-Provence, and extensive R&D programs in support of these objectives, including joint experiments involving the major international tokamak facilities, was agreed at the International Energy Agency (IEA)-ITPA Joint Experiments Workshop at the Massachusetts Institute of Technology in December. The FST Department contributed to a successful ITER International Summer School in Japan attended by graduate students from ten countries. It also coordinated preparations for the ITER presentations to the 22nd Fusion Energy Conference held in Geneva in October. In all, 60 papers were presented at this Conference on behalf of ITER by staff of the ITER Organization and the Domestic Agencies and by experts from the Members' fusion communities.

Department for Administration (ADM)

In the Administration Department, staff levels increased, data management systems came on line, and organizational infrastructure was set into place during the year.

Data management progressed in 2008 with the implementation of the Dynamic ITER Administrative Management System (DIAMS), including the Cognos tool for budget and SAP for procurement, finance and human resources. The implementation of DIAMS provides our Organization with a number of advantages: the system ensures that data from different sources can be integrated; and that this data is secure, consistent, traceable and auditable. It will also ensure budget control, and interfaces with schedule and cost tools developed by the Project Office.

The Finance and Budget division had responsibility early in the year for finalizing the 2007 accounts. In November, the ITER Council approved the estimated 2008 budget, as well as the draft budget for 2009, the interim draft budget for 2010 and the preliminary draft

budget for 2011. Following this, the division formulated the 2008 ITER Organization budget by department. The Council approved the final 2008 conversion rate of 1 IUA = 1.49816 k Euro, and the provisional 2009 rate of 1.52962 k Euro.

The Financial Audit Board (FAB) met twice during the year in Cadarache, and conducted its first on-site audit in April. Independent auditors from the seven Members of the ITER Organization audited files, records of assets, and cash and bank statements, and presented their results to the ITER Council during its June meeting. The FAB also made an interim audit visit in September, preparing for the audit of the Financial Statements 2008.

In 2008, the ITER Organization concluded a Partnership Arrangement for ten years with the Principality of Monaco, which includes an annual contribution of 550000€ towards Postdoctoral Fellowships and communication actions by ITER. Five candidates were selected in November for the Monaco ITER Postdoctoral Fellowships; these candidates will take up their positions in early 2009.

The Procurement and Contract division developed procurement forecasts in conjunction with the Project Office that were distributed to all Deputy Director-Generals in February in order to help the departments place their contracts and procurements in a timely fashion. The division standardized working practices and worked throughout the year to prepare contracts, Task Agreements and consultancy agreements in support of the project ensuring competition wherever possible.

In the Human Resources division, the process of signing five-year contracts was completed in January for those staff members who had been under temporary contracts since 2006/2007.

137 positions were posted and more than 40 temporary staff recruited. Staffing levels grew from 193 to 300 during the year. The Human Resources division was responsible for drawing up the ITER Organization staffing plan, supporting the departments in the elaboration of job descriptions, posting positions, processing applications, conducting interviews, and proposing recruitments to the ITER management.

A draft procedure for the annual staff appraisal was concluded, and training was organized for both supervisors and employees. The annual staff appraisal exercise was finished in May. In 2008, the ITER Organization elected its first Staff Committee with five staff representatives. Several all-hands meetings were held on pension scheme, social insurance, taxation, and privileges and immunities. A draft for internal regulations for staff working at Headquarters was implemented together with a document on working conditions on the ITER site for non-ITER staff. The ITER Organization was recognized during the year by the International Administrative Tribunal of the International Labour Organization (ILOAT).

Construction of the Extension 2 temporary buildings for 146 people on the Cadarache site was completed in February. The new ITER Headquarters building was completed with ITER taking possession in November. The Logistics team was centrally involved in the process of selecting security guard services and access control, as well as in preparing the telephone network, improvement of the power supply, organizing office equipment and moving staff. The team provided logistics support throughout the year to meetings taking place in the Cadarache Château.

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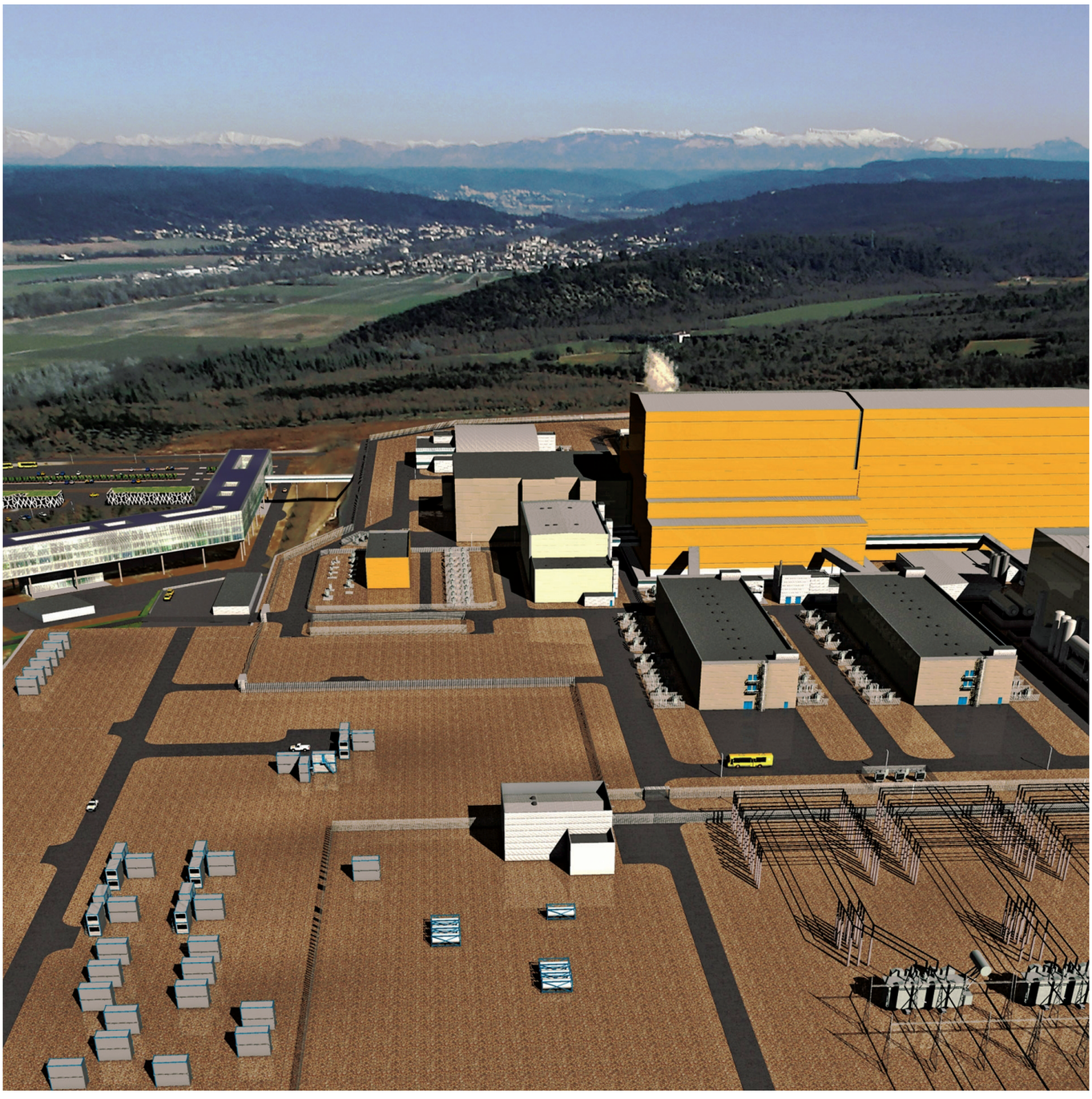

ITER aims to demonstrate that fusion is an energy source of the future.

Staffing Tables

by Nationality

Member	01/01/08	31/12/08
China	12	15
EU	121	199
India	4	13
Japan	16	23
Korea	14	16
Russia	15	18
USA	11	16
Total	**193**	**300**

by Department

Department	Professional	Support	Total
Department for Administration (ADM)	17	12	29
Civil Construction and Site Support Office (CCS)	9	3	12
Department for Central Engineering and Plant Support (CEP)	41	24	65
Department for Codac and IT, Heating and CD, Diagnostics (CHD)	34	11	45
Department for Fusion Science and Technology (FST)	13	1	14
Office of Audit Service (OAS)*	1	0	1
Office of the Director-General (ODG)**	11	7	18
Project Office (PRO)	36	11	47
Department of Safety and Security (SAS)	10	3	13
Department for Tokamak (TKM)	50	6	56
Total	**222**	**78**	**300**

* Office of Audit Service

** Office of the Director-General

Financial Tables

Summary of Commitments Account

2008	Commitment Apprpriations	Commitments	Carry forward to 2008
Title I: Direct Investment	0.600	–	0.600
Title II: R&D Expenditure	18.768	18.752	0.016
Title III: Direct Expenditure	85.277	84.984	0.293
Total	**104.645**	**103.736**	**0.909**

Summary of Payments Account

2008	Payment Appropriations	Payments	Unused Balance	Special Account at 31 December 2008
Title I: Direct Investment	0.100	–	0.100	–
Title II: R&D Expenditure	20.443	9.250	–	11.193
Title III: Direct Expenditure	94.346	75.512	–	21.834
Total	**114.889**	**81.762**	**0.100**	**33.027**

In-kind Contributions by Member

Member	In Mio Euro
China	–
EU	0.150
India	0.075
Japan	–
Korea	–
Russia	–
USA	0.449
Total	**0.674**

For Secondments—Credit Allocations for 2008

Member	In Mio Euro
China	–
EU	9.978
India	–
Japan	0.874
Korea	0.399
Russia	–
USA	1.334
Total	**12.585**

All figures in Mio Euros

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