FUSION FOR ENERGY

Consolidated Annual Activity Report (CAAR) of

The European Joint Undertaking for ITER

Development of Fusion Energy

(Fusion for Energy – F4E)

[In pursuance of FR 1605/2002, FFR No 1271[1]/2013]

1 REGULATION (EU) No 1271/2013 of 30 September 2013 on the framework financial regulation for the referred to in Article 208 of Regulation (EU, Euratom) No 966/2012 of the European Parliament and of the Council

Fusion for Energy

The European Joint Undertaking for ITER
and the Development of Fusion Energy
C/ Josep Pla 2
Torres Diagonal Litoral
Edificio B3
08019 Barcelona
Spain

Tel: +34 933 201 800
Fax: +34 933 201 851
E-mail: info@f4e.europa.eu

fusionforenergy.europa.eu

Table of Contents

List of Acronyms

A/E	Architect Engineer
ABAC	(Accrual-based Accounting); Accounting and budgetary tool of the European Commission and F4E
AC	Audit Committee
AHG	Ad-Hoc Group
AMC	Administration and Management Committee
ANB	Authorised Notification Body
B2B	Business-to-business
BA	Broader Approach Agreement
BAUA	Broader Approach Units of Account
BCM	Blanket Cooling Manifold
BIPS	Buildings, Infrastructures and Power Supplies
Body PS & MHVPS	Body Power Supply and Main High Voltage Power Supply
BPM	Business Process Management
BPM	Business Process Management
BSM	Blanket Shield Module
CA	Contract Agent
CAAR	Consolidated Annual Activity Report
CAD	Computer Aided Design
CAS	Credit Allocation Scheme
CB	Cryostat Base
CEL	Conventional Exceptional Loads
CER coils	Continuous External Rogowski coils
CMA	Construction Management-as-agent
CMM	Cassette Multifunctional Mover
CN-DA	Chinese ITER Domestic Agency
COSO	Committee of Sponsoring Organizations of the Treadway Commission
CPRHS	Cash and Plug Remote Handling System
CS	Central Solenoid
CSC	Computational Simulation Centre
CVB	Cold Valve Boxes
CVBCS	Cryostat Vessel Body Cylindrical Section
CW	Continuous Wave
CW gyrotron	Continuous Wave gyrotron
CW pumping station	Cooling Water pumping station
DA	Domestic Agency
DACC	Deviations Amendments and Contract Changes tool
DACC	Deviations Amendments and Contract Changes tool
DC	Direct Current
DCC	Document Comment Communication
DEMO	Demonstration Fusion Reactors
DG ENER	Directorate-General for Energy
DNB	Diagnostic Neutral Beam

DP	Double Pancake for superconducting magnets
DR	Deviation Request
D-T	Deuterium-Tritium
DTP	Divertor Test Platform
DWS	Detailed Work Schedules
EAC	Estimate At Completion
EBBTF	European Breeding Blanket Test Facilities
EC	Electron Cyclotron
ECA	European Court of Auditors
ECH	Electron Cyclotron Heating
EcoSys®	Enterprise Project Control System
ECPS	Electron Cyclotron Power Supplies
ECRH	Electron Cyclotron Resonance Heating
ECT	Electron Cyclotron
EDPS	European Data Protection Supervisor
EF	Equilibrium Field
EPC	Enterprise Project Control System
EU	European Union
EU-DA	European Union ITER Domestic Agency (Fusion for Energy)
EUROFER	A 9% Chromium reduced activation ferritic-martensitic steel
EUROfusion	European Consortium for the Development of Fusion Energy
EVEDA	Engineering Validation and Engineering Design Activities
EVM	Earn Value Management
F4E	Fusion for Energy
FAT	Factory Acceptance Test
FC	Framework Contract
FO	Official
FP7 grants	Seventh Framework Programme for Research and Technological Development European Union grants
FR/IR	Financial Regulation/Implementing Rules
FSP	Full-Scale Prototype
FTE	Full Time Equivalent
FW	First Wall
FWC	Framework Contract
GB	Governing Board
GDoIs	General Declarations of Interest
GHe tank	Gas Helium Tank
H&CD	Heating and Current Drive
HCLL	Helium-Cooled Lithium-Lead
HEL	Highly Exceptional Loads
HFTM	High Flux Test Module
HHF	High Heat Flux
HIP	Hot Isostatic Pressing
HNB	Heating Neutral Beam
HPC	Hold Point Clearance
HP-EU	Hold Point – European Union
HR	Human Resources

HRS Water treatments	Heat Rejection Water treatments
HTS CL	High Temperature Superconducting Current Leads
HV	High Voltage
HVPS	High Voltage Power Supply
I&C	Instrumentation and Control
IAC	Internal Audit Capability
IAEA	International Atomic Energy Agency
IAEA	International Atomic Energy Agency
IAS	Internal Audit Service
IC	ITER Council
IC	Ion Cyclotron
ICH	Ion Cyclotron Heating
ICRH	Ion Cyclotron Resonance Heating
ICT	Information and Communication Technology
IDM	ITER Document Management (software)
IFERC	International Fusion Energy Research Centre
IFMIF	International Fusion Materials Irradiation Facility
IMS	Integrated Management System
IMSS	Integrated Management System Standards
IN-DA	Indian ITER Domestic Agency
IO	International Organisation
IP	Intellectual Property
IPR	Intellectual Property Rights
IPR	Internal Panel Review
IPTs	Integrated Project Teams
IRS	Integrated Reporting System
ISC	Improvement Steering Committee
ISEPS	Ion Source and Extraction Power Supplies
ISS	Isotope Separation System
IT	Information Technology
ITER IO	ITER International Fusion Energy Organization
IUA	ITER Unit of Account
IVT	Inner Vertical Target
IVVS	In-Vessel Viewing System
JAEA	Japanese Implementing Agency
JET	Joint European Torus
JA-DA	Japanese ITER Domestic Agency
KO-DA	Korean ITER Domestic Agency
KPI	Key Performance Indicator
LC	Load Centre
'Lean Six Sigma' methodology	A set of techniques and tools for process improvement
LIFUS	Lithium for Fusion
LIPAc	Linear International Fusion Materials Irradiation Facility Prototype Accelerator
LN2	Liquid Nitrogen

MAD	Material Acceptance Document
MAP	Multi-Annual Plan
MFF	Multi-Annual Financial Framework
MITICA	Megavolt ITER Injector and Concept Advancement
MS	Management Standards
MS	Management Standards
MTA	Milestone Trend Analysis
MV DC	Mega Volt Direct Current
NB	Neutral Beam
NBI	Neutral Beam Injector
NBTF	Neutral Beam Test Facility
NbTi	Niobium Titanium
NHF	Normal Heat Flux
NPC	Notice to Commence work
NRC	Non-Conformity Report
OLAF	European Anti-Fraud Office
OPS	Overall Project Schedule
PA	Procurement Arrangement
PBS	Plant Breakdown Systems
PCC	Procurement and Contracts Committee
PCR	Project Change Request
PCR	Pre-Compression Rings
PF	Poloidal Field
PGM M/IMP	Programme Management and Implementation
PoE	Port of Entry
PPEN	Pulsed Power Electrical Network
PRIMA	Padova Research on ITER Megavolt Accelerator
PS	Power Supply
PSM	Project Steering Meeting
PTC	Prototype Torus Cryopump
Q1/2/3/4	Quarter
QA	Quality Assurance
QA	Quality Assurance
QC	Quality Control
QC	Quality Control
QMS	Quality Management System
QPC	Quench Protection Circuit
R&D	Research and Development
RAMI	Reliability, Availability, Maintenance and Inspection
RAMIO	Reliability, Availability, Maintenance and Inspection Officer
RAPID	F4E-developed tool which follows up on the implementation of audit actions
RASCI	Responsible, Accountable, Support, Consulted and Informed
RF	Radio Frequency
RFE	Ready for Equipment
RFQ	Radio Frequency Quadrupole
RH	Remote Handling

RMV	Requirements Management and Validation
RF-DA	Russian ITER Domestic Agency
RWM	Resistive Wall Mode Control
RWMPS	Resistive Wall Modes (Coils) Power Supplies
SAT	Site Acceptance Test
SCMPS	Superconducting Magnets Power Supplies
SF6 gas	Sulphur hexafluoride gas
SMEs	Small and Medium Enterprises
SNE	Seconded National Expert
SOAP	Sign-Off Authorisation Policy
SPI	Schedule Performance Index
SPIDER	Source for Production of Ions of Deuterium Extracted from Radio Frequency plasma
SR2FP	Straight Road to First Plasma
SRF Linac	Superconducting Radio Frequency Linear Accelerator
SSEN	Steady State Electrical Network
TA	Temporary Agent
TAP	Technical Advisory Panel
TB	Tokamak Building
TF	Toroidal Field
TSS	Technical Support Services
US-DA	United States ITER Domestic Agency
VC	Voluntary Contributor
VV	Vacuum Vessel
WBS	Work Breakdown Structure
WDS	Water Detritiation System
WP	Work Programme
WRL	Warm Regeneration Lines
WRS	Warm Regeneration System

List of Figures:

List of Tables:

Governing Board's Analysis and Assessment

The Governing Board,

Having regard to art 14 of the Statutes annexed to the Council decision 2007/198/Euratom establishing the European Joint Undertaking for ITER and the Development of Fusion Energy.

1. Welcomes the announcement of the ITER Organization confirming that in 2018 the overall project had reached 60% of the total construction work scope to First Plasma based on ITER's project performance metrics, including design, component manufacturing, building construction, shipping and delivery, assembly, and installation.
2. Welcomes the progress made on the development of the European contribution to the ITER project in 2018 and, in particular, notes:
    a. F4E delivered six ITER Council or Governing Board milestones planned in 2018. F4E has now delivered 14 out of 15 ITER Council milestones for 2016 – 2018
    b. In 2018 F4E achieved 93 % of all its internal milestones compared to 91 % in 2017 and 70 % in 2016.
    c. The overall progress on the ITER buildings and power supplies, including the completion of the Tokamak pit bioshield, the installation of the two big sector subassembly tools in the assembly hall and the connection of the four 400kV transformers to the French electrical grid. The GB notes that the complexity of the buildings and their integration to the tokamak systems is a standing threat to the cost and schedule and welcomes F4E´s continuous overseeing of the projects in that respect.
    d. The progress with the ITER magnets, including the successful leak test of the first three European Toroidal Field (TF) coil winding packs and the insertion of the first winding pack into the TF case provided by Japan, this successful step will pave the way for the completion of the first ITER TF coil by 2020.
    e. The improvement in the coordinated European-wide industrial effort in the fabrication of the vacuum, vessel with the active involvement of additional large companies from France, Germany and Spain. However, the GB notes that the pace of fabrication still needs improvement and welcomes the close scrutiny of all the project steps by F4E.
    f. The progress in the fabrication and qualification of prototypes for the main in-vessel systems under European responsibility, including the successful high flux test of the first full-size Inner Vertical Targets of the Divertor and the completion of the first prototype of first wall panel as well as the successful key step, beryllium armour joining, for the other two prototypes.
    g. The progress in the development of the ITER negative neutral beam injectors, with the inauguration of the SPIDER beam source at NBTF (Padova).
3. Congratulates F4E on the excellent progress of the projects under the Broader Approach in collaboration with Japan, including the delivery of the last two TF coils and the cryostat body for the JT60 project, which keeps the objective of first plasma in 2020, the progress on the installation of the LIPAC, with the commissioning of the first beam pulses through the radiofrequency quadrupole, and the first full test of remote operation from the Remote Experiment Centre performed by running experiments at the WEST tokamak (Cadarache) from the Rokkasho remote control room.

4. Welcomes that F4E continues to forecast that it will remain within the agreed cap of 6.6Bn€ on commitments up to the end of 2020 and that the projected expenditure until 2035 remains within the estimates in the 2017 Commission Communication to Council on ITER.
5. Welcomes both the full implementation of the commitment appropriations at the level of 98% of the final annual budget, and the payment appropriations at the level of 96%, which represents an excellent outcome given the inherent uncertainties with which F4E has to contend.
6. Notes that The European Court of Auditors has expressed an unqualified opinion on the 2017 financial accounts.
7. Notes the recommendations made by the independent Annual Assessment of F4E, which analysed in September –November 2018 the effectiveness of F4E's performance, with focus on schedule control, cost containment and risk management, and has requested an Action Plan from F4E management.
8. Welcomes the full implementation of the Enterprise Project Control System (EPC) "EcoSys®", a key tool for better commitment and payment forecast and control of elements like cost estimate at completion and budget allocation.

For the Governing Board,

Joaquín Sánchez
Chair of the F4E Governing Board
10 July 2019

Introduction

F4E in Brief

Fusion for Energy (F4E) is a Joint Undertaking created under the Euratom Treaty by a decision of the Council of the European Union (EU)[2]. F4E was established for a period of 35 years from 19 April 2007 and its seat is located in Barcelona, Spain.

The main tasks of F4E are as follows:

- In relation to the obligations stemming from the ITER International Agreement: **to provide the contribution of the European Atomic Energy Community (Euratom) to the ITER International Organisation for ITER**, the world's largest scientific partnership that aims to demonstrate fusion as a viable and sustainable source of energy;
- In relation to the obligations stemming from the Broader Approach Agreement with Japan: to provide components, equipment, materials and other resources for **Broader Approach activities** and to prepare and coordinate Euratom's participation in the implementation of Broader Approach activities.
- In relation to a demonstration fusion reactor (DEMO): to prepare and coordinate a programme of research, development and design activities other than ITER and Broader Approach activities, **in preparation for the construction of a demonstration fusion reactor and related facilities,** including the International Fusion Materials Irradiation Facility.

F4E has the following members which can be likened to "shareholders":

- Euratom, represented by the European Commission;
- The member states of Euratom;
- Third countries which have concluded cooperation agreements with Euratom in fusion that associate their respective research programmes with the Euratom programmes and which have expressed their wish to become members.

The current members are therefore the 28 Member States of the European Union, Euratom and Switzerland as a third country.

Each member sits in the **Governing Board**, the main body which supervises F4E. The he following committees assist the Governing Board and/or the F4E Director: The **Bureau** assists the Governing Board in the preparation of decisions; the **Administration and Management Committee** which provides advice or recommendations to the Governing Board or the F4E Director on specific matters related to the administrative and financial planning of F4E; The **Procurement and Contracts Committee** provides the F4E Director with recommendations on procurement, contract and grant activities; the **Technical Advisory Panel** assists the Governing Board and Director in engineering, scientific and technological matters related to ITER, the Broader Approach and preparations for demonstration fusion reactors (DEMO); and the Audit Committee is an advisory committee to the

2 Council decision 2013/791/Euratom of 13 December 2013 Amending Decision 2007/198/Euratom establishing the European Joint R and the Development of Fusion Energy and conferring advantages upon it.

Governing Board and has an overview of financial reporting and accounting; governance, Internal Control and Risk Management; external audit and internal audit.

Executive Summary/The Year in Brief

During 2018, F4E has continued to consolidate a suite of improvements, optimising its performance and stabilising the schedule and cost of projects. As this report demonstrates, these actions are bearing fruit but a sustained effort is required. The following achievements characterise the period covered by this report:

- F4E delivered six ITER Council or Governing Board milestones planned in 2018. F4E has now delivered 14 out of 15 ITER Council milestones for 2016 - 2018 demonstrating the EU's commitment to the Project;
- In 2018 **F4E achieved 93 % of all its internal milestones** compared to 91 % in 2017, 70 % in 2016 and 75 % in 2015– this improvement is attributed to improved planning and project management;
- The ITER Organisation reported in December 2018 that **the ITER Project reached 60 % (up from 50 % in 2017) of the total construction work scope to reach the First Plasma** milestone in 2025;
- Throughout 2018, **F4E's Cost Estimate at Completion (EAC) remained within the €$_{2008}$ 6.6bn cap until 2020** and the EAC until 2035 within the estimates in the 2017 Communication to Council on ITER;
- Progress on the **ITER construction site was impressive − F4E completed the huge bioshield encircling the Tokamak Pit** and **the first components were installed in the Tokamak Complex**;
- F4E achieved a very important milestone – the **insertion of the first core of the 18 superconducting Toroidal Field (TF) magnets into its casing.** This is the culmination of work that involved over 600 people from more than 26 EU companies;
- European companies manufactured three full-size prototype Blanket First Wall Modules. The first full-size Inner Vertical Targets of the Divertor successfully passed thousands of cycles of high-heat flux testing;
- F4E installed many components of the enormous Cryoplant in the Cryoplant Building at the ITER site including all the cryogenic tanks and cold boxes;
- F4E provided new opportunities to EU companies and laboratories to work on many ITER technological projects by signing 71 operational contracts and grants in 2018 for € 163m, as well as € 273m of amendments to existing contracts, increasing the total investment by F4E to nearly € 5bn;
- F4E managed and supported major EU contributions to the Broader Approach fusion projects with Japan, bringing EU contributions by end-2018 to 95 % (JT-60SA tokamak), >90 % (IFMIF) and >98 % (IFERC) of completing;
- F4E implemented a further 6 out of 15 pending actions from the 2016 Action Plan, bringing the total implemented to 82 %. In response to the 2018 Council Conclusions 11 new actions were added of which one was already implemented;
- F4E fully utilised its commitment and payment appropriations from its 2018 budget (respectively 98.4 % and 96.1 % of the final annual budgets). In April 2018 the European Parliament granted 'discharge' to the F4E Director for the 2016 annual accounts;
- F4E reduced the portfolio of audit actions with the closure of three internal audits. The implementation rate of internal audit actions remained high at 79 % reflecting the importance that F4E attaches to continuous improvement.

Part I. Achievements of the Year

1.1 Contributions to the ITER Project

1.1.1 Introduction

ITER is under construction in Cadarache in the south of France. Europe as the Host Party and France, as Host State, have special responsibilities for the success of the Project. Europe bears 45.46 % of the construction cost including all the buildings. It will provide 34.00 % of the cost of operation, deactivation and decommissioning of ITER[3].

Europe has budgeted €$_{2008}$ 6.6bn until the end of 2020 according to the July 2010 decision of the Council of which most is earmarked for contracts placed by F4E with European industry, SMEs and research laboratories. In 2018, F4E provided new opportunities to EU companies and laboratories to work on many ITER technological projects by signing 71 operational contracts and grants for € 163m, increasing overall investment since 2007 to € 4.02bn;

The following subsections present a brief report on a selection of the activities undertaken in 2018 on the major systems needed to achieve 'First Plasma' in ITER (marking the start of ITER operations), namely Site and Buildings (subsection 1.1.2.1 Site and Buildings), Vacuum Vessel (1.1.2.2 Vacuum Vessel) and Magnets (1.1.2.3 Magnets).

The subsequent subsections within this chapter deal with the many other complex, first-of-a-kind technological systems for ITER, most of which are still in the design and development phase, which Europe is responsible for. The ITER schedule requires installation of some of these systems, fully or partially, before First Plasma, although delivery, in most cases, is only required for subsequent assembly phases[4].

1.1.2 Major Achievements in EU First Plasma Systems

1.1.2.1 Site and Buildings

Thirty-nine buildings and areas will house the systems necessary for the operation of ITER. The 'Tokamak Complex' will house the main ITER components, and will be one of the largest buildings of its type ever constructed: 60 metres tall (with an additional 20 metres underground), 120 metres long and 80 metres wide; requiring 16 000 tonnes of iron reinforcement bars, 150 000 m³ of concrete and 7 500 tonnes of steel.

As shown in Figure 1, the two subterranean levels of the Tokamak Complex are complete and civil engineering works up to the seventh floor are now at full speed. The thick cylindrical concrete bio-shield, which surrounds the ITER machine, is now complete and the Tokamak Central Pit has been delivered for early access to the ITER Organization in April 2018. From 2019 other floors of the Tokamak Building

[3] *Final Report of Negotiations on ITER Implementation, 1 April 2006. Attachment 2_C*

[4] *The tables which are included in sections 1.1, 1.2 and 1.3 refer to Annual Objectives in the F4E Work Programme 2018, Second Amendment. The codes are listed in order to be able to identify the milestones in F4E's Primavera schedule*.

will be delivered every six months to the ITER Organization allowing plant system assembly. The main critical Milestone, to be achieved in March 2020, will grant crane access between Assembly Hall and Tokamak Building, to enable ITER Organization to start bringing large components into the Tokamak pit.

Inside the Tokamak Complex, the civil works of the concrete crown which will support the 23 000 tonne weight of the Tokamak machine were completed in August 2018 with the final finishing works to be completed by Summer 2019. The ITER Organization installed the first machine component, a Poloidal Magnet Feeder in the Tokamak Pit in November 2018 as shown in Figure 2. The painting and finishing of the basement levels of the Tokamak Complex have progressed allowing the ITER Organization to start installing the first components in the Diagnostic Building (B74) Basement 2 Level in December 2018. In the lower floors of the Tokamak Complex, 5 huge Port Cell Doors (weighing more than 50 tonnes each) that will allow access to the Tokamak Machine and laboratories have now also been installed, with a further 41 remaining to be installed through 2019 and early 2020.

Installation works are underway in the 60-metre-tall Assembly Hall, adjacent to the Tokamak Complex. The ITER Organization has made significant progress with the erection of the two Sector Sub Assembly Tools. Load testing is now complete on the main cranes, capable of lifting a combined weight of 1 500 tonnes, with commissioning and handover to the ITER Organization completed in April 2018. The building services installation is also progressing with handover of the building planned in 2019.

A major milestone was reached in September 2018 when the four 400kV transformers of the Steady State High Power Substation (Area 35) were successfully energised and connected to the French National Grid. Subsequently, the Main Alternating Current Distribution Building was energised with the ITER site power source switched from CEA to the French Réseau de Transport d'Électricité (RTE) in January 2019.

In December 2018 the buildings housing the Hot Basin with a capacity of 26 000 m^3, heat exchangers and pump station became the first buildings to be officially handed over from F4E to the ITER Organization. The next handover is planned for March 2019 when the Magnet Power Conversion Buildings (B32/B33) will be completed, signalling another major delivery from Europe to the ITER project.

Both the cost of the buildings works to date and the scheduled duration have substantially exceeded initial estimates as a result of numerous changes to the design, scope and to the implementation of design development, in particular for the Tokamak Complex. These changes were mostly at the request of the ITER Organization.

In late 2015, by benchmarking against other civil engineering projects, independent expert assessments concluded that a much larger budget contingency for the buildings work should have been set aside in 2010. A ‘Reserve Fund’ created in 2015 at the level of the whole ITER Project now provides a mechanism to compensate F4E (and other Domestic Agencies) for subsequent change requests, however not for those of the past.

F4E and the ITER Organization, in consultation with F4E’s Governing Board, are working closely together to minimise the ongoing cost increases and schedule delays.

F4E has further implemented organisational, project-management-related, scope-related and contractual measures to stabilise this project, giving priority to the First Plasma milestone. These include:

- Postponement or de-scoping (including future optimisation) of non-First Plasma buildings;
- Design-to-cost, resulting in changes asked by F4E from the ITER Organization;
- Dedicated variation and claim management team established by F4E;
- Dedicated re-measurement team on the worksite:
- Permanent on-site supervision;
- Very conservative approach in the Change Control Board towards any changes;
- Permanent optimisation of construction methods and processes;
- Maximum acceleration of civil works to contain run-rate related cost and secure the First Plasma schedule

Annual Objectives 2018				
Milestone ID/ Objectives	**Scope Description**	**Forecast Achievement date**	**Type of milestone**	**End of December 2018 Schedule Status**
EU62.05.010	IPL > Tokamak Building (11) RFE 1B - Stage 1 (RFE #1)	Q2 2018	GB11/ IC33	Achieved
IO.1435.882190	IPL > Cryostat Support Bearings ready for installation	Q1 2018	GB55/ IC32	Achieved
EU62.05.604050	Completion of concrete crown Civil Works	Q3 2018	GB08/ IC24	Achieved
EU62.052910	NPC- TB03 RFOC Tokamak Building (11) level B2	Q4 2018	GB09/IC25	Achieved

Table 1: Site and Buildings and Power Supplies – Annual Objectives presented in the F4E Work Programme 2018, Second Amendment

Figure 1: The ITER construction site showing the Tokamak Complex on the left. Photo: The ITER Organization (November 2018)

Figure 2: The first machine component, a Poloidal Magnet feeder was introduced in the Tokamak pit (November 2018)

1.1.2.2 Vacuum Vessel

The ITER plasma, where the fusion reactions will take place, will be under vacuum inside a special double-walled container, the **Vacuum Vessel**. This doughnut-shaped vessel is 19 metres across and 11 metres high. It weighs in excess of 5 000 tonnes, similar to the Eiffel Tower.

F4E is providing five of the nine Vacuum Vessel 'sectors'. Manufacturing is time-consuming and labour-intensive due to the size of the sectors (13.6 metres high, 6.5 metres wide, 7.8 metres deep and weighing 400 - 500 tonnes).

Due to below-target production rates of the EU consortium (AMW) manufacturing the Vacuum Vessel, F4E reinforced AMW's in 2017 with industries qualified to work in the nuclear field from Spain, France, Italy and Germany. The main objectives were to:

- Increase the number of staff dedicated to the management of the project;
- Issue a new schedule as the reference for measuring progress after its approval by F4E and the ITER Organization;
- Qualify and start manufacturing activities in the new companies coming on board;
- Meet production targets according to Key Performance Indices for production based on the new reference schedule.

In the first half of 2018, AMW continued to ramp-up production of the manufacturing of all 20 segments of the five EU sectors in parallel. For the first three sectors, production entered the sub-assembly phase. This will last for about 18 months for each sector and end with the welding of the outer-shell, the last operation before final segment machining and assembly of the four sectors.

From May 2018, AMW gave particular attention to increase the production rate of sector 5, while subsequent sectors were benefitting of the lessons learned from this first sector. However, an overall slow-down in production occurred in the second half of 2018 due mainly to issues with weld quality and nuclear safety.

F4E formally requested AMW to provide a plan to recover generated delays and to focus on increasing the production rate of sector 5 as the top priority. The Vacuum Vessel production remains one of the projects that is subject to intensive project control and supervision by F4E Management and staff.

Annual Objectives				
Milestone ID	**Scope Description**	**Forecast Achievement Date**	**Type of Milestone**	**End of December 2018 Schedule Status**
EU15.1A.1138920	Sector 5 Poloidal Segment (PS3) – Right Hand Port Region Sub – Assembly	Q4 2018	Predecessor of IC58/GB16	Achieved
EU15.1A.1130230	Sector 9 Poloidal Segment 2 (PS2) – Central Port Sub Assembly	Q4 2018	Predecessor of GB25	Achieved

Table 2: Vacuum Vessel – Annual Objectives presented in the F4E Work Programme 2018, Second Amendment.

Figure 3: The triangular support subassembly for the fourth segment for the fifth Vacuum Vessel sector, manufactured by Mangiarotti in Italy and electron-beam welded at Pro-beam in Germany

1.1.2.3 Magnets

30 superconducting magnetic coils confine the hot plasma inside ITER and prevent it from touching the walls. These are among the largest and most powerful such magnets ever made.

F4E is providing 10 of 19 Toroidal Field (TF) coils, 20 % of the Nb3Sn superconductor for the TF coils, five of six Poloidal Field (PF) coils, 11 % of the NbTi superconductor for the PF coils and nine fibreglass 'pre-compression rings', which keep the coils in place during operation.

Annual Objectives				
Milestone ID/ Objectives	**Scope Description**	**Forecast Achievement Date**	**Type of Milestone**	**End of December 2018 Schedule Status**
EU11.3B.29020	Placing DP8 for PF5 (stacking)	Q3 2018	Predecessor of IC42/GB12	Achieved
EU11.1A.22822	Completion of TF-EU01 WP Insertion and Butt Welding	Q4 2018	Predecessor of IC53/GB15	WP insertion and tack welding achieved. Butt welding will be achieved in 2019 due to the 1st TF Coil Case late arrival plus the delay to resolve an unexpected non-conformity of the delivered TF Coil Case.
EU11.3B.559320	PF6 Winding Pack Stacking Completed	Q4 2018	Predecessor of IC54/GB14	Achieved

Table 3: Magnets – Annual Objectives presented in the F4E Work Programme 2018, Second Amendment.

1.1.2.3.1 Toroidal Field Magnets

Each **Toroidal Field (TF) coil**, weighing 310 tonnes, comprises a superconducting **Winding Pack (WP)**, mounted in a stainless steel case. To form the WP, seven **Double Pancakes (DPs)** are impregnated with a special resin and then stacked together.

Each DP consists of a D-shaped stainless steel plate with spiral grooves on both sides that support two 700-metre-long length of superconductor, wound into shape, heat-treated and electrically insulated before insertion into the grooves.

All 70 DPs required for the 10 TF coils were fabricated (winding, heat treatment and impregnation) and five out of ten WPs completed by the end of 2018. Each WP is 14 metres long by 9 metres wide, 1-metre-thick and weighs 110 tonnes. Its fabrication is the culmination of many complex and highly technical operations involving more than 600 people from more than 26 EU companies.

In 2018, the first three WPs were successfully leak, cold and electrically tested at the insertion facility. This culminated with the insertion of the first WP into the TF coil case supplied by Japan (Figure 4). This very important achievement paves the way for F4E to complete the first TF coil in early 2020. In general, the TF coil delivery dates are driven by the arrival dates of the TF coil casings from the Japanese Domestic Agency.

1.1.2.3.3 Poloidal Field Magnets

European industries led by F4E are fabricating four giant Poloidal Field (PF) coils (up to 25 m in diameter) under Europe's responsibility at the PF coil factory at the ITER site. Another is being fabricated in China under contract with F4E, at the Institute of Plasma Physics, Chinese Academy of Sciences-ASIPP.

At the ITER site, seven DPs were wound, four DPs were impregnated and the stacking started (Figure 5) for the first PF coil (PF5). However, by the end of 2018 it was clear that production was not running smoothly due to high staff turnover, skill levels and shop floor organisation. For this reason, in 2019 F4E is reorganising the current supplier contracts scheme to stabilise the production dates.

In China, production of the PF coil (PF6) experienced a big leap forward. All nine DPs were wound, impregnated, stacked and joined. WP ground insulation also started in order deliver the coil to the PF Coils Building in Cadarache in 2019 (Figure 6). With a diameter larger than 10 metres, once complete the PF6 coil will be the heaviest Poloidal Field coil, weighing some 400 tonnes.

1.1.2.3.4 Pre-Compression Rings

F4E is providing all nine **Pre-compression Rings (PCRs)** that keep the 18 TF Coils in place during ITER operation.

Each PCR is made from fiberglass and epoxy resin, weighs > 3 tonnes and has a diameter of 5.5 metres. These will be among the largest composite structures ever manufactured as a single piece.

F4E has investigated two manufacturing processes. Initially, the PCRs were to be made with automated filament placement technology ("Plan A"). However, a "Plan B" using pultrusion technology was launched in parallel as a risk mitigation action in case Plan A was not successful. In 2018 the pultrusion technology was qualified and chosen for the series production (Figure 7).

Figure 4: Insertion of the first Toroidal Field Winding Pack into its coil case in Italy

Figure 5: Poloidal Field (PF5) Double Pancake being transferred to stacking station in Cadarache.

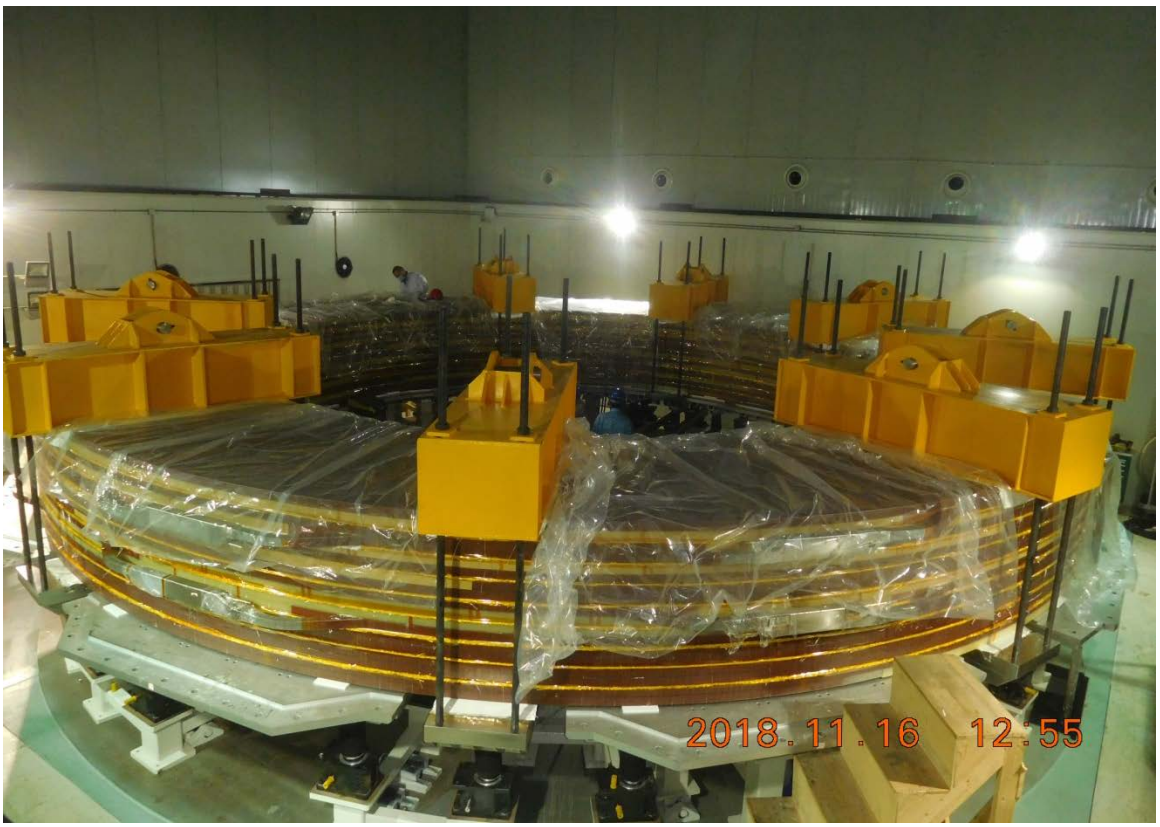


Figure 6: Stacking of the Poloidal Field Double Pancakes (PF6) in China

Figure 7: Pre-Compression Ring slice after machining, manufactured with pultrusion technology, France

1.1.3 Achievements in Other EU Systems

Europe is responsible for many other complex, first-of-a-kind technological systems for ITER, most of which are largely in the design and development phase. Even if not all are required for the First Plasma milestone, the 'Staged Approach' of the updated ITER schedule requires installation of some parts of these systems (e.g. 'captive' components) before First Plasma that are impossible or very costly to install at a later date.

1.1.3.1 In-Vessel Components

Whilst the ITER magnets will confine most of the hot plasma, radiation and some particles will inevitably escape from this magnetic 'cage'. To protect the Vacuum Vessel and the external systems from this energy flux, the inside surface of the Vacuum Vessel will be covered by 440 special blocks, called Blanket Modules.

Each module is made from a Shield block and a **First Wall panel**. Europe will provide 215 First Wall panels. The cooling water of all the Blanket Modules is supplied by pipe bundles running inside recesses at the back side of the Shield Blocks: the **Blanket Cooling Manifolds**, which are also to be delivered by Europe. The blanket system removes heat from the inside of the Vacuum Vessel and transfers it to the Tokomak Water Cooling System.

A device at the bottom of the Vacuum Vessel, the **Divertor**, removes excess heat and plasma 'ash' keeping the plasma clean enough to continue operation. F4E is responsible for many key components of the Divertor, in particular the **Inner Vertical Target** and the **Cassette Body**, which is the supporting structure of the Divertor plasma facing components (Inner and Outer Vertical Target and Dome).

The main achievements in 2018 for the **Blanket First Wall** was the successful joining of the Beryllium armour for all the three full-scale prototypes under manufacture by the three companies competing for the future series production. For one of the prototypes all the main manufacturing operations have been finalised (Figure 8) and the factory acceptance tests are due to start at the beginning of 2019.

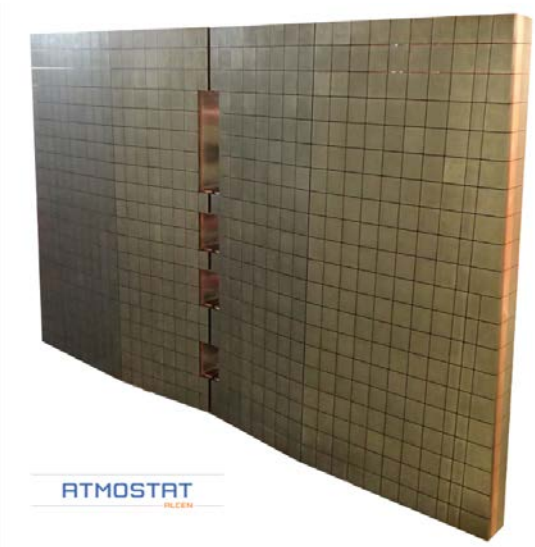


Figure 8: First wall panel full-scale prototype

For the **Blanket Cooling Manifold**, work has focused on the development of an alternative support design, the so-called “bolted design”, expected to be cheaper than the current baseline design based on diffusion bonded parts. Finite element analyses were used to optimise the design. F4E manufactured prototypes and underwent thermomechanical tests. At the end of the qualification phase, an updated configuration arrangement will be defined with the ITER Organization Central Team (IO-CT) and a revised cost estimate of the Blanket Cooling Manifold will be obtained.

Regarding the **Divertor components**, the first full-scale Plasma Facing Units’ test assembly of the Inner Vertical Target passed successfully the high heat flux (HHF) testing program at the Efremov Institute (St. Petersburg, Russian Federation) (Figure 9). The cassette body full-scale prototypes fabricated by the two companies competing for the series production have been completed and successfully passed the ITER Organization acceptance tests. After reopening of competition between both companies, F4E awarded two contracts for Stage 1 of the Cassette Body series production.

Annual Objectives				
Milestone ID/ Objectives	**Scope Description**	**Forecast Achievement Date**	**Type of Milestone**	**End of December 2018 Schedule Status**
EU.16.01.21310	Non Destructive Examination after CuCrZr/Be Hot Isostatic Pressing for Full Scale Prototype – OPE-443 Lot 2	Q4 2018	Predecessor of GB 37	Achieved

Table 4: In-Vessel (Blanket) – Annual Objectives presented in the F4E Work Programme 2018, Second Amendment.

Annual Objectives				
Milestone ID/ Objectives	**Scope Description**	**Forecast Achievement Date**	**Type of Milestone**	**End of December 2018 Schedule Status**
EU17.2B.010733	Delivery of the first all-tungsten prototype test assembly of the Divertor Inner Vertical Target to the RF test facility	Q3 2018	Predecessor of GB 20	Achieved
EU17.01.100050	Contract signed for the Cassette Body series production	Q4 2018	Predecessor of GB 38	Achieved

Table 5: In-Vessel (Divertor) – Annual Objectives presented in the F4E Work Programme 2017, Second Amendment.

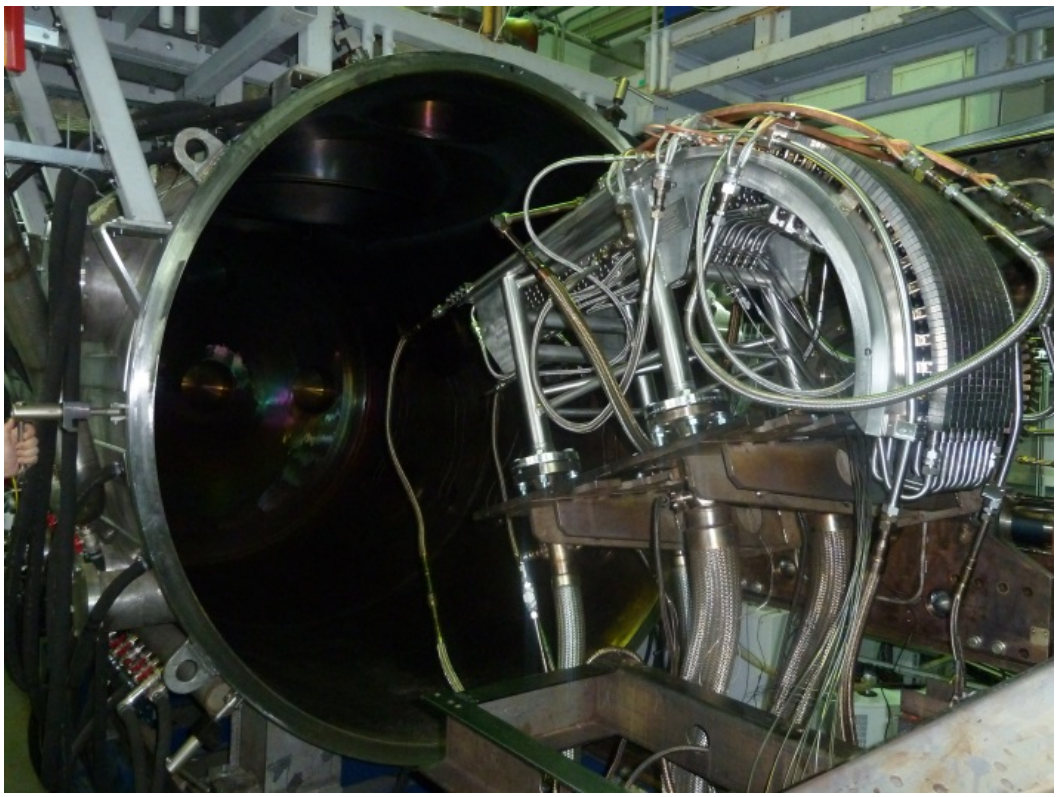


Figure 9: Inner Vertical Target test assembly ready for testing at high heat fluxes

1.1.3.2 Breeding Blanket Modules

Europe will test in ITER a necessary feature of future fusion reactors: the generation of their own fuel. Tritium is one of the two fusion fuels (the other being deuterium); and, unlike deuterium, tritium is not naturally available. To that end, F4E will test two breeding systems on ITER called **Test Blanket Modules (TBM)**, which are experimental tools to validate tritium "breeding" for future fusion reactor concepts. The TBMs are not part of the EU's in-kind contributions to ITER.

In 2018, F4E and EUROfusion[5] have agreed on a new joint organisation of their resources in research programmes for breeding blanket technology. This has led to the creation of a joint Project Team for the co-operation of the European TBM project using joint resources; as well as in a technical re-alignment of the TBM project scope with respect to longer-term Breeding Blanket DEMO programme. For that purpose, a water-cooled TBM is replacing one of the two helium-cooled TBM concepts developed by F4E. This change has been accepted by the ITER Organization and is cost-neutral for F4E.

As a first collaborative action of the joint TBM Project Team, EUROfusion laboratories under the technical coordination of F4E have developed the pre-conceptual design of a water-cooled TBM System (Figure 10). The next phase will bring the joint team to the conceptual design review by the ITER Organization in 2020.

[5] *EUROfusion, the 'European Consortium for the Development of Fusion Energy', manages and funds European fusion research activities on behalf of Euratom.*

The TBMs comprise steel boxes containing the tritium breeder, neutron multiplier materials and heat extraction plates. In 2018, F4E has signed a contract with industrial partners for the development of welding tools and definition of welding procedure for the most complex part of the TBM box: the manifold area that is distributing the coolant flow to the structures. In addition, an optimisation of advanced fabrication techniques (e.g. hot isostatic pressing) for the assembly of the box itself is under consolidation in the same contract.

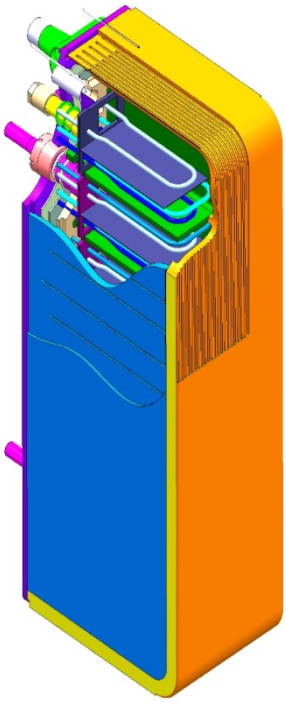


Figure 10: Water-Cooled Lead-Lithium (WCLL) Test Blanket Module (TBM) – Conceptual design developed in collaboration between F4E and EUROfusion

Europe's chosen steel for the TBMs is known as EUROFER97 and has been developed to withstand neutron irradiation. In 2018, F4E's contractor has achieved the irradiation of several hundreds of EUROFER97 samples in the HRF reactor of NRG (the Netherlands). Post irradiation mechanical testing are ongoing and with result in introducing design limits for irradiated EUROFER97 in the RCC-MRx nuclear construction code. The end objective is to have EUROFER97 becoming a standard also for longer-term programmes of DEMO.

In 2018, F4E has also pursued engineering design activities for the helium-cooled TBM System, in particular for its Tritium Accountancy and Data Acquisition Systems that are fundamental equipment for the mission of the TBM programme in ITER. F4E has also collaborated with the ITER Organization for the final engineering design of TBM connection pipes, which will be the first TBM Systems' equipment installed in ITER as captive components.

The regulatory obligations for nuclear pressurised equipment progressed in support of a Notified Body contracted in a consulting role were implemented: first regulatory documents have been drafted in view of the future conformity assessment procedure. F4E signed a new contract with a Notified Body (milestone 2018) to further analyse how specificities of the TBM box welding should be taken into account within the regulatory qualification and conformity assessment procedure.

Several other accompanying R&D actions have also progressed during 2018, such as the developing of a new version of a code simulating tritium transport in TBM Systems; an experimental campaign was conducted for validation of sensors and instruments in Pb-16Li environment; upgrading of the TRIEX loop at ENEA-Brasimone (Italy); and analysis of thermal-hydraulic experiments to verify the general performance of the TBM PbLi loop components in normal operation and emergency situations.

Annual Objectives				
Milestone ID/ Objectives	**Scope Description**	**Forecast Achievement Date**	**Type of Milestone**	**End of December 2018 Schedule Status**
EU56.02.1218560	Task Order signed for preliminary Welding Procedure Specification (pWPS) of TBM Box Manifold Area	Q2-2018	WP18 objective	Achieved
EU56.01.1235700	Task Order signed for Support from Agreed Notified Body (ANB) for welding procedures qualification	Q4-2018	WP18 objective	Achieved

Table 6: Test Blanket Modules – Annual Objectives presented in the F4E Work Programme 2018, Second Amendment.

1.1.3.3 Remote Handling

Remote Handling (RH) will play an essential role in ITER. Once the fusion reactions will have produced significant radiation and activation of the ITER components, robotic tools will be required to inspect and repair components close, or within, the ITER machine. This is challenging since some of the items weigh up to 50 tonnes and need precision positioning. F4E will provide many elements of ITER's RH systems; the **Divertor Remote Handling System (DRHS)**, the **Cask and Plug Remote Handling System (CPRHS)** for transportation of the components from thw Tokamak to the Hot Cell Building, the **Neutral Beam Remote Handling System (NBRHS)** and the **In-Vessel Viewing System (IVVS)**. All contracts are in place for the design of these RH systems.

For the DRHS, in 2018 the main effort has been in order to bring the design to the preliminary design review stage. This is the culmination of a multi-year design effort and indeed. Since the DRHS is a complex plant system spanning from in vessel to hot cell, F4E has been required to approve a tremendous amount of technical documentation and submit it to the review panel. All the experience gained from this review is useful for the future.

In the CPRHS area (a massive plant system spanning all across tokamak and hot cell buildings and with eight different cask variants), during 2018 the main technical achievement has been the setting up of the detailed technical specifications which are fully consistent with the F4E Requirements Management & Verification processes. This is a significant first step of the preliminary design phase, which paves the way for the detailed design development.

Preliminary NBRHS design activities started including operational, functional and hazard analysis. In parallel, sub-system specifications and designs have been initiated. Work has focused on the overhead

monorail crane (major first plasma system), considering seismic uncoupling solutions, together with more detailed mechanical designs of the crane itself. Other subsystems are being redesigned such as the beam source opening mechanisms and the beam line transporter rails system,

The IVVS design has been further developed to increase its reliability, cope with recent interface changes and reach a definition suitable for preliminary design review. While the deployment system concept has remained relatively stable, the IVVS scanning probe has evolved significantly to include a hybrid viewing and metrology system. A full-scale prototype of the scanning probe has been built and the lab tests yield very promising performance, at times exceeding ITER's requirements.

Common RH technologies to industrialise radiation resistant technologies, advanced in 2018. F4E designed, manufactured and tested radiation-resistant integrated circuits and started prototyping a radiation-resistant image sensor. F4E also progressed on remote diagnostics, computer assisted teleoperation and control system software.

Annual Objectives				
Milestone ID/ Objectives	**Scope Description**	**Forecast Achievement Date**	**Type of Milestone**	**End of December 2018 Schedule Status**
EU23.03.90770	TO for Preliminary Design Phase 1 (system specifications) for CPRHS completed (ADP Approved)	Q4 2018	Predecessor of GB32: Task Order Signed for Manufacturing for CPRHS	Achieved

Table 7: Remote Handling – Annual Objectives presented in the F4E Work Programme 2018, Second Amendment.

1.1.3.4 Cryoplant & Fuel Cycle

The ITER Cryoplant, a complex system and one of the largest of its type in the world, will provide the cryogenic fluids necessary to cool ITER's superconducting magnets. F4E is responsible for the **Liquid Nitrogen Plant and Auxiliary Systems**, about one-half of the Cryoplant, along with part of the network to distribute and regulate the cryogenic fluids; the **front-end Cryodistribution lines** and **Cold Valve Boxes**. F4E is also providing all the main **Cryopumps**, which maintain a high vacuum in the Vacuum Vessel and the Cryostat.

As well as being an expensive resource, tritium is radioactive. Careful management and recycling of tritium on ITER is therefore essential. This is the purpose of the Tritium Plant, a part of which will be provided by Europe; consisting of a **Water Detritiation System** and a **Hydrogen Isotope Separation System**.

One of the highlights of 2018 is the start of the installation of the LN2 Plant and Auxiliary Systems in the Cryoplant building. In particular, all the major equipment, compressors, cold boxes and tanks have been installed. The piping prefabrication was close to completion by end-2018 while the on-site mechanical piping fitting and welding was started.

Another major milestone was the delivery of four tritiated water-holding tanks in May 2018. They will be part of the water detritiation system of the tritium plant. Two of them are feeding tanks and the two other

ones are high level holding tanks. They were already installed in the underground level B2 of the Tokamak complex.

The manufacturing of the warm regeneration lines made good progress. The branch lines passed factory acceptance tests. The manufacturing of the main lines is in progress. All the lines are scheduled to be delivered in two batches during the first semester of 2019.

F4E placed contracts for the manufacturing of the MITICA cryopump. A first manufacturing readiness review was held. The procurement of long lead items and qualification of the technologies were initiated. The manufacturing set up and procedures for the charcoal coating of the cryopanels were ready for acceptance.

F4E awarded two contracts to procure the front-end cryopump distribution system. The design phase of the cold valve boxes and warm regeneration box was started. The kick-off meeting of the contract for the cryojumpers and Johnston couplings was held.

Two major procurement arrangements were signed. The first one was for the Torus and Cryostat Cryopumping System, which pumps the vacuum vessel and cryostat volumes and which includes eight cryopumps. The second is for the leak detection systems required to detect potential leaks from the vacuum vessel, cryostat and neutral beam equipment.

Figure 11: On-site installation of the LN2 Plant and Auxiliary Systems

Figure 12: Two tritiated water holding tanks being delivered to Cadarache

Annual Objectives				
Milestone ID/ Objectives	**Scope Description**	**Forecast Achievement Date**	**Type of Milestone**	**End of December 2018 Schedule Status**
EU31.01.125640	Contract signed for manufacturing and factory testing of Torus and Cryostat Front-end cryodistribution	Q3-2018	Predecessor of GB28	Achieved
EU31.01.10550	PA 3.1.P1.EU.03 Documentation received from IO	Q1-2018	Predecessor of GB33	Achieved
EU31.01.20620	Contract signed for final design, manufacturing and delivery of Johnston couplings and cryojumpers	Q4-2018	Predecessor of GB28	Achieved

Table 8: Cryoplant and Fuel Cycle – Annual Objectives presented in the F4E Work Programme 2018, Second Amendment.

1.1.3.5 Plasma Diagnostic Systems

Operating ITER successfully will require the availability of comprehensive information on the behaviour of the fusion plasma. This information will allow the safe operation of ITER, optimisation of the plasma configuration for maximum performance and comparisons between that performance and our theoretical understanding. Around fifty different systems ('**Diagnostics**') will measure parameters of the plasma, together with those of the First Wall Blanket Modules and Divertor. Europe is responsible for **twelve Diagnostics and eight ancillary systems**. So far, 60 European research laboratories and SMEs are involved in the design, development and/or manufacture of these systems.

Many Diagnostics have components or subsystems that must be installed before ITER First Plasma, in some cases beginning as early as 2019, and are thus a top priority for F4E. In this context, F4E has manufactured and successfully tested a full-scale prototype of a vacuum electrical feedthrough. Seventy-eight of these feedthroughs will transmit more than 2 000 electrical signals across the safety barrier separating the low-pressure plasma in the ITER Vacuum Vessel from the external atmosphere. Another first plasma diagnostic system is the set of magnetics sensors. These sensors – usually small coils of wire – will measure the magnetic fields generated in ITER, to provide detailed information needed to control and optimise the plasma. In 2018, F4E signed a contract for delivery of the first components of the magnetics sensors to be mounted inside the Vacuum Vessel, for delivery starting in 2019, as well as signing two contracts for design of the electronics and software for these sensors.

In order to get a good view of the ITER plasma, eight EU Diagnostics must sit right at its edge: in one of the most challenging environments on ITER. Diagnostic Shielding Modules, or DSMs, provide a 'safe home' for these Diagnostics; giving support and protecting the delicate Diagnostic components whilst shielding the environment from ITERs neutrons. These steel structures are mounted in ITERs port plugs and weigh up to 3 tonnes each. F4E will supply nine such modules; installed in the five Diagnostics port plugs (of 18 in total on ITER) that F4E is providing. Because the DSMs, and the diagnostics themselves, cannot be handled by humans, maintenance and repair must the done by Remote Handling; where sophisticated manipulators, remotely controlled by operators, must replace a technician's trained hand. F4E tested during 2018 the Remote Handling compatibility of its DSMs at the RACE facility of Culham Centre for Fusion Energy. These successful tests showed conclusively that the F4E DSM design is well-optimised for remote handling maintenance of port-based diagnostics, a key milestone in our design activities.

Several Diagnostics rely on collecting, focussing and transporting light from the plasma using optical components in the Port Plugs. These Diagnostics use mirrors in various different shapes and sizes, but typically measuring up to 250 x 200 millimetres, to reflect light from the plasma towards detectors and cameras. While the number of mirrors can vary depending on the Diagnostic system, all in all, the ITER optical Diagnostic systems will contain 70 mirrors. The harsh conditions of the ITER plasma are likely to create deposits on the mirrors closest to the plasma, causing a loss of their reflectivity and decreasing the performance of the Diagnostic. During 2018, F4E demonstrated that full-size prototypes of mirrors can be cleaned using a flux of energetic particles to remove the deposits. F4E is further developing this technology for integration into ITER.

The total radiated thermal power of ITER's plasma will be measured by Bolometers which measure tiny changes in resistance due to temperature rises in a small block of material that absorbs the radiation. During 2018, F4E signed a contract to produce prototypes of the bolometer sensors, which undergo extensive testing in 2019 to confirm their reliability in the challenging environment inside the ITER Vessel, include tests in a fission reactor to simulate the radiation exposure they will experience in ITER.

Annual Objectives				
Milestone ID	**Scope Description**	**Forecast Achievement Date**	**Type of Milestone**	**End of December 2018 Schedule Status**
EU55.01.75260	Contract Signed for Analysis Software Algorithm Design	Q3 2018	Predecessor of GB 39	Achieved
EU55.06.681260	Preliminary Design Review Meeting for Feedthroughs (PDR meeting) closed	Q3 2018	Predecessor of GB 36	Achieved

Table 9: Diagnostics – Annual Objectives presented in the F4E Work Programme 2018, Second Amendment.

1.1.3.6 Plasma Heating Systems

To create fusion in ITER, the plasma needs to reach 150 million degrees. By passing a large electrical current through the plasma, which also helps to hold it in a magnetic 'cage', it is possible to reach 20 - 30 million degrees. Since this is not enough on its own, ITER relies on three additional heating systems.

1.1.3.6.1 Neutral Beam Heating

One of the most reliable ways to heat plasmas in present-day fusion experiments is to fire a beam of fast, uncharged particles into the plasma – called **Neutral Beam Injection**. ITER will have two (or three if needed) Neutral Beam Injectors and Europe is responsible for providing most of their components. Neutral Beam Injectors work by generating an electrically charged form of Deuterium ('ions') in an 'ion source'. A high voltage accelerates a beam of these ions to a high energy. Collisions with Deuterium gas neutralise ions in the beam to create the high-energy neutral beam.

To develop and test the Neutral Beam Injectors a dedicated facility was set up in Padua, Italy – known as the **Neutral Beam Test Facility**. The facility hosts two test beds:

- **SPIDER** (**S**ource for **P**roduction of **I**ons of **D**euterium **E**xtracted from **R**adio Frequency plasma) where the ion source will be tested up to an acceleration voltage of 100,000 volts; and
- **MITICA** (**M**egavolt **IT**ER **I**njector & **C**oncept **A**dvancement) which tests the injector up to the full acceleration voltage of one megavolt (1 MV) and power of 16.5 megawatts (16.5 MW).

An ITER Council Milestone was achieved by F4E in 2018 with the installation of the **SPIDER** Beam Source (Figure 13) and all the systems (cooling, gas injection and vacuum pumping, control and interlock, beam source, vacuum vessel, power supplies, transmission line and essential diagnostics). The inauguration of SPIDER operation was celebrated in June 2018 and the first plasma was produced.

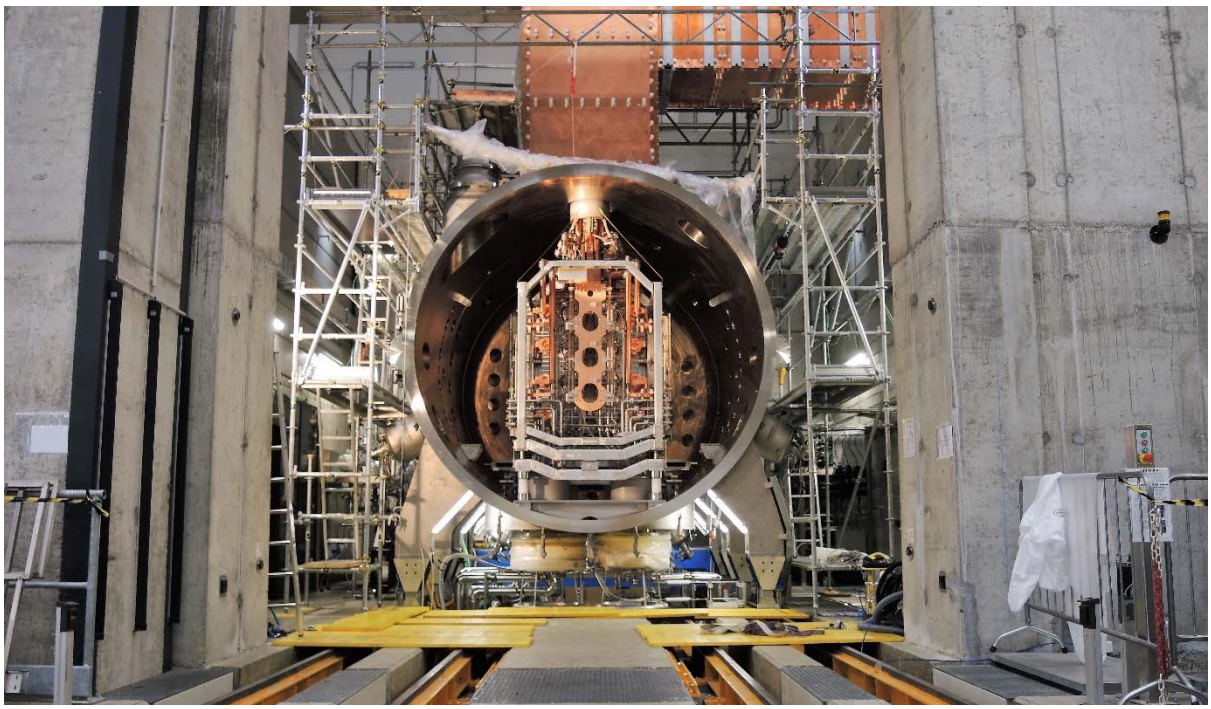


Figure 13: The SPIDER Beam Source ready for start of operation at RFX, Padova

In 2018 F4E concluded a € 24m contract to deliver the **MITICA** beam source and work started in November. F4E also made significant progress with the MITICA power supplies. The installation of the High Voltage Deck, insulated for a voltage of 1 million volts was completed and all tests passed. Site acceptance tests of the MITICA power supply conversion systems were also passed among other achievements.

The first stage of work for the MITICA Beam Line Components was completed with three industrial partners providing manufacturing design deliverables. This paves the way for manufacturing to begin in 2019. Installation of MITICA auxiliary systems (cooling, vacuum and gas introduction) continued in 2018 including installation of the large MITICA cryoplant.

Annual Objectives				
Milestone ID	**Scope Description**	**Forecast Achievement Date**	**Type of Milestone**	**End of December 2018 Schedule Status**
EU52.04.11603	Start of manufacturing of PS set#3	Q2 2018	Predecessor of GB 43	Achieved
EU53.TF.05500	SPIDER Ready for Integrated Commissioning	Q1 2018	IC30/GB20	Achieved

Table 10: Neutral Beam and EC Power Supplies and Sources – Annual Objectives presented in the F4E Work Programme 2018, Second Amendment.

1.1.3.6.2 Radio and Microwave Heating Systems

Another way to heat up the plasma is to use radio waves to make the ions and electrons in the plasma vibrate, much like the way a microwave oven heats food. ITER is using two systems: **Ion Cyclotron**

(IC) Heating, which heats the ions, and **Electron Cyclotron (EC) Heating**, which heats the electrons. Each system comprises power supplies, radio wave generators, transmission lines to transport the radio waves and antennae inside the Vacuum Vessel to launch them into the plasma.

F4E is responsible for providing two equatorial port plugs (each housing one **IC Antenna**) and four upper port plugs (each housing one **EC Upper Launcher**), together with ex-vessel components of both the EC Upper and Equatorial Launchers and control systems for the EC plant and Upper Launchers. It should be mentioned that one full EC upper launcher is required to achieve First Plasma.

IC Antenna design work was advanced in 2018 with the aim of simplification and solution of issues at Preliminary Design Review level. In the meantime, the ITER Organization IC Team decided to internalise the antenna design and R&D. Data, reports and models have been transmitted to the ITER Organization, and the design activity in F4E is now closed.

F4E is also responsible for providing **eight sets of power supplies** for the EC Heating system and **six gyrotrons**, with their superconducting magnets and auxiliaries. Gyrotrons are high power microwave generators.

Progress in 2018 for the EC Upper Launcher and waveguides systems included the baseline revision of the port plug design, as well as adaptation to the electron cyclotron wave loads. In addition, qualification activities for the plasma-facing parts of the Upper Launcher were successful.

In 2018 the commissioning of the components of the “Falcon” facility at the Swiss Plasma Center was completed (Figure 14) and it is now fully operational and ready for testing the EC Launcher and waveguide components.

The first deliverable of the EC plant control system Procurement Arrangement is the system to support the testing of the Gyrotron control systems at the suppliers’ factory; this has been achieved and was accepted by the ITER Organization and the corresponding credit request approved. The design of “Stage 2” which is the control system able to drive the Gyrotron commissioning plant and the first plasma operation was presented and approved in a design review with the ITER Organization and all interfacing Domestic Agencies. An advanced prototype of “Stage 2”, implemented by F4E in the “Falcon” test facility, is now operational.

Commissioning and factory acceptance tests for the first EC power supplies were completed. The power supplies performance exceeded specifications. The cryogenic free magnet was delivered to the Swiss Plasma Center and site acceptance tests successfully completed. The magnet met the challenging technical specifications and is the first time that such a magnet using ‘cryogen-free’ technology is built in Europe.

Figure 14: The prototype 1MW European gyrotron installed and undergoing testing in the new "Falcon" facility at the Swiss Plasma Center in Switzerland

Annual Objectives				
Milestone ID	**Scope Description**	**Forecast Achievement Date**	**Type of Milestone**	**End of December 2018 Schedule Status**
EU51.01.204392	ADP Approval for Development of Titanium-stainless steel rotary friction welding	Q1 2018	Predecessor of GB31	Achieved
EU52.01.115190	Final documentation for EC UL Diamond Disk FDR closure accepted by F4E	Q2 2018	Predecessor of GB22	Achieved
EU52.01.340285	Independent review of Qualification programme for EC UL Isolation Valve performed	Q2 2018	Predecessor of GB46	Achieved

Table 11: Antenna and Plasma Engineering – Annual Objectives presented in the F4E Work Programme 2018, Second Amendment.

1.2 Contributions to the Broader Approach Projects

1.2.1 Introduction

In addition to acting as ITER Domestic Agency for Europe, F4E is also the Implementing Agency for the EU contribution to three Projects under the **Broader Approach (BA) Agreement** between Euratom and Japan. The Broader Approach Agreement was negotiated in parallel with the ITER agreement to carry out activities complementary to ITER aiming at a faster realisation of fusion as an energy source.

Under the BA Agreement, Euratom and Japan contribute equally to projects taking place in Japan (€ 338m and ¥ 46bn respectively, values of 5 May 2005). Several Member States (France, Italy, Germany, Spain, Switzerland, and Belgium - the **Voluntary Contributors**) committed to provide approx. 90 % of the EU contributions in-kind. F4E is the Implementing Agency for the BA, which coordinates the voluntary contributions and is also in charge of a limited amount of procurement.

The three projects are nearing the full completion, planned by March 2020, for what concerns BA-Phase I. During 2018 progress has been made between the Parties and the two Implementing Agencies for the following five years where it is expected that research and enhancements will be conducted in what has been proven to be a very successful collaboration between the EU and Japan.

Annual Objectives				
Milestone ID/ Objectives	**Scope Description**	**Forecast Achievement Date**	**Type of Milestone**	**End of December 2018 Schedule Status**
IFMIF-EU-PA-04-A	Task order signed for SRF Linac transportation Part 2	Q4 2018	WP18 objective	Achieved
REC (Remote Experimentation Centre)	Contract signed for WEST tests (preparations + missions)	Q3 2018	WP18 objective	Achieved

Table 12: Broader Approach – Annual Objectives presented in the F4E Work Programme 2018, Second Amendment.

1.2.2 Main Contributions

1.2.2.1 Satellite Tokamak Project

The **Satellite Tokamak Project** (or JT-60SA), located in Naka (Japan), consists of the upgrade of an existing tokamak (of comparable size to the EU Joint European Torus (JET) tokamak) into a superconducting device capable of long pulse operation, with the aim of carrying out experiments which should be complementary to those studied in ITER. This upgrade involves the complete dismantling of

the old device, the refurbishing and reutilisation of the buildings, the power supplies systems and the additional heating system.

By the end of 2018, as it can be visible in Figure 15, the assembly of the torus is now in an advanced state. F4E has delivered all TF coils, the last two of which by air transport to save time, the cryostat and additional equipment, reaching its targets to achieve 95 % of the whole project Earned Value. Following such deliveries, the closure of the torus has been accomplished. All 20 (18+2 spares) TF coils have been fully tested at full current and cryogenic temperature demonstrating a consistent temperature margin, and in line with the predictions.

With the target of a First Plasma in September 2020, the system construction process is now progressing with the installation of the upper Equilibrium Field (EF) coils, the Central Solenoid, Cryostat Thermal Shield, internal cryolines, magnet feeders, etc. At the same time the commissioning of plant systems is now underway with a view to start the full integrated commissioning towards first plasma to be started in March 2020.

Presence of F4E personnel at the Naka site in Japan contributed to the implementation of complex on-site assembly and commissioning operations, as well as successfully integrating EU suppliers in the Japanese safety and management environment. In addition, the extended presence of F4E personnel in Japan ensured training and assistance for critical assembly operations.

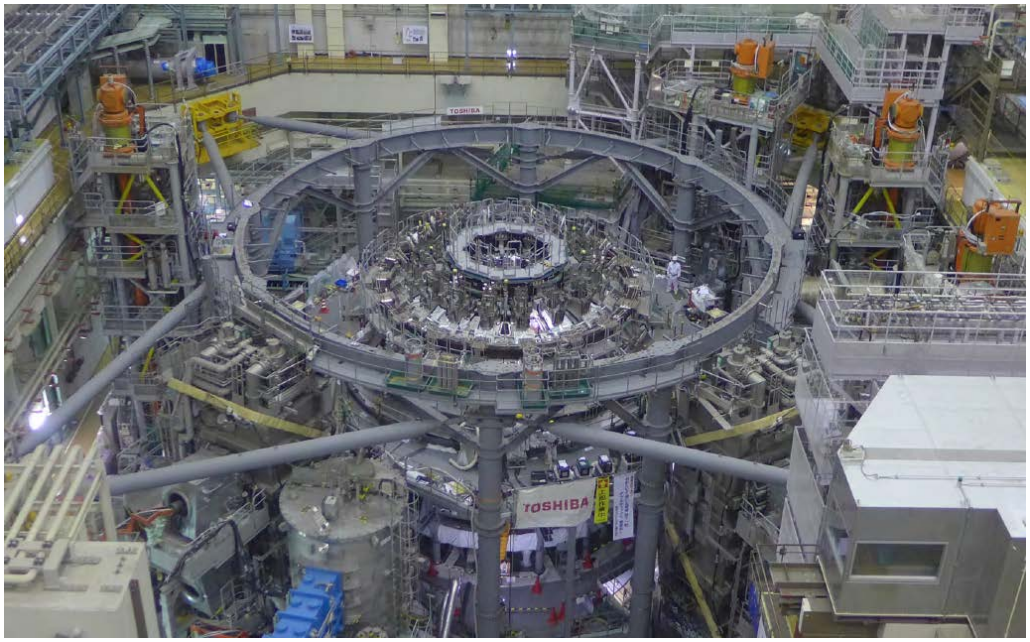


Figure 15: JT-60SA tokamak assembly status (December 2018): Completed Torus Assembly

1.2.2.2 IFMIF/EVEDA Project

The **International Fusion Materials Irradiation Facility - IFMIF** is an accelerator-based neutron source to produce a large neutron flux to qualify materials for future fusion reactors. The Engineering Validation and Design Activities (EVEDA) for IFMIF are being conducted in Rokkasho (Japan).

The **Linear IFMIF Prototype Accelerator – LIPAc** reached an important milestone in 2018 by commissioning the subsystems for short pulse beam transmission through the Radio Frequency Quadrupole with a good efficiency. To prepare for continuous operation, the High Energy Beam

Transport line components and the High Power Beam Dump were delivered to Rokkasho and installed (Figure 16). In 2019, it is planned that all the components necessary for the cryomodule assembly will be available on Rokkasho site and the upgrade of the beamline will be done in order to enable operation towards high duty cycle (high mean power) at 5 MeV. This will allow to demonstrate the performance of all the components of the LIPAc accelerator apart from the cryomodule, while the latter is assembled.

1.2.2.3 IFERC Project

The **International Fusion Energy Research Centre (IFERC)** Project is hosted in Rokkasho (Japan) and comprises three sub-projects.

The first sub-project, the **Computational Simulation Centre's (CSC)** "Helios" supercomputer provided resources to the EU and Japanese fusion scientific and technical communities from 2012 to 2016. In 2018 the CSC prepared the framework for an exchange of computer time between EU and Japanese that will allow joint projects in their respective supercomputers.

The second sub-project, **DEMO activities**, aims to reinforce collaboration with EUROfusion and of merging the materials research activities into the Demonstration Reactor (DEMO) design planning. In 2018 the DEMO Activity Integrated Project Team continued to investigate key issues, which impact the main machine parameters and specifications for pre-conceptual DEMO designs. The joint JET tile/dust analysis provided important knowledge on the tritium accumulation in the JET wall components, with results of interest for ITER and DEMO.

The third IFERC sub-project, **ITER Remote Experimentation Centre – REC,** achieved an important milestone in 2018. One of the aims of this sub-project is to support the remote participation of EU scientists in the JT-60SA experiment by developing appropriate tools. The control room in Rokkasho, which was fully equipped in 2017, was used for the first integrated test of remote participation in a working session of Tokamak WEST in Cadarache. After some preparation work in WEST to allow remote access, two scientists from WEST were invited to act as remote session leaders from Rokkasho. The test involved the preparation of pulse schedules at REC, the submission of these to the WEST engineer in charge for local validation, real time observation of the resulting plasma discharge in WEST, and access to the data for post-pulse analysis. Local authorities press and high school students were invited to witness the test. (Figure 17).

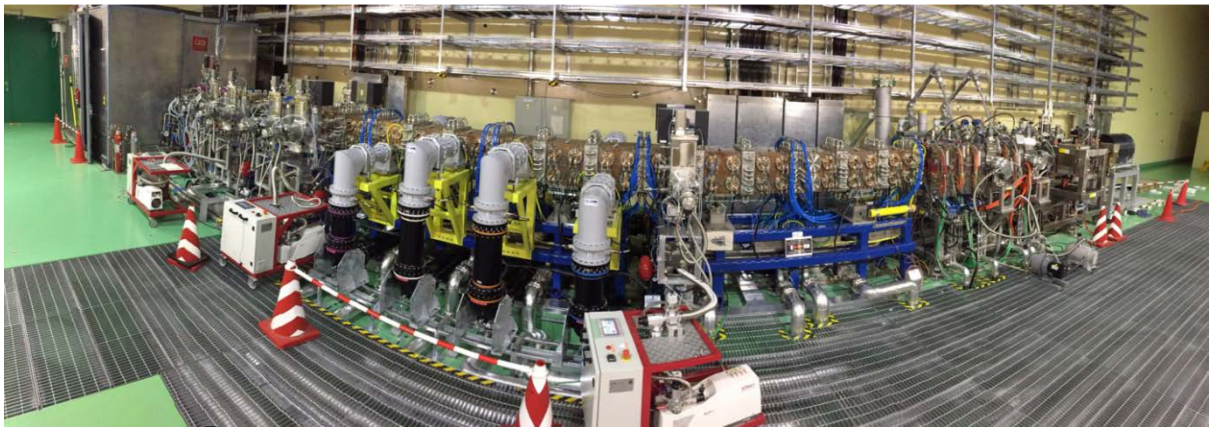


Figure 16: Wide Angle photo of the LIPAc accelerator in Rokkasho

Figure 17: Remote Experimentation Centre: group photo of the REC and Cadarache teams

1.3 Technical Support Activities

1.3.1 Technical Support Services

The Technical Support Services team in F4E provides specific technical expertise in engineering and fusion technologies to the F4E Project Teams delivering systems to the ITER Project and, to a more limited extent, also supports the Broader Approach Projects. Technical support is provided in the following areas:

- **Design office activities (mechanical and schematics):** Providing Computer Aided Design (CAD) support to F4E's Project Teams in setting up the CAD infrastructure for design collaboration with suppliers and the ITER Organization, reviewing drawings for Procurement Arrangement signature, warranting the traceability of CAD data exchanges, checking the CAD data at the different design maturity levels (conceptual design, detailed design, manufacturing design, as built design), performing in-house mechanical design tasks and specifying CAD tasks to be subcontracted. The group has been reinforced in the Site, Buildings and Power Supplies (BIPS) Project Team participating actively in the Holistic Integration Team to solve integration issues of TB04 systems in the Tokamak Complex. Tolerance studies have been performed to estimate the final sector tolerances of a proposal for the final machining of the European Vacuum Vessel sectors at segment level. Activities have been performed to provide CAD support to the Magnets, In-Vessel, Remote Handling, Cryoplant & Fuel Cycle, TBM & Materials Development, Neutral Beam & EC Power Supplies & Sources, Diagnostics and Antennas & Plasma Engineering Project Teams;
- **Analysis (mechanical, structural dynamics, civil engineering, fluid dynamics, electro magnetism, nuclear analyses):** Providing technical support in computational analysis for development of the ITER design, both in-house and by placing and following up service contracts with qualified suppliers. A new Framework Contract for mechanical analyses is available. Most analyses were made to support the Vacuum Vessel, Magnets and Buildings design. Nuclear analysis to compute the ITER radiation map in the tokamak machine was also in the focus of the group activities;
- **Design Codes and Standards:** Tracking developments in, and the application of, standard codes (e.g. ASME, RCC-MR) to the design of the key ITER mechanical components (e.g.: Vacuum Vessel, Buildings and Magnets); assuring the ACO role (Analyses & Codes) in the review of all technical specifications prepared by F4E; managing F4E code & standards repository and consultations from teams;

- **Engineering Support:** Completing a pilot contract for expert engineering support to test a different short-term support tool on behalf of F4E's Project Teams;
- **Reliability, Availability, Maintenance and Inspection (RAMI):** Coordinating internally with F4E Project Teams and with ITER Organization/Operations all actions concerning RAMI processes. In 2018 a RAMIO (Reliability, Availability, Maintenance and Inspection Officer) role has been added to Sign-Off Authorisation Policy (SOAP) for the review of RAMI deliverables by suppliers;
- **Assembly, Integration and Validation (AIV):** Coordinating internally within F4E and with the ITER Organization Construction Department the processes and policies involving assembly duties. In 2018, the scope of work has mostly focused on construction documentation;
- **Instrumentation and Control:** Providing integrated solutions to projects; from support and consultancy to fully managed product developments. Provides necessary development and managerial/technical support resources to the development and integration of plant system instrumentation, from the conception to the final acceptance: control system modelling and design, electronics modelling and design, requirements analysis and formalisation, system design and documentation, preparation of design reviews, FAT (Factory Acceptance Test) and SAT (Site Acceptance Test) manning;
- **Metrology:** Defining a metrological strategy, preparing technical specifications and following up project activities related to metrology. Support is provided for: the preparation of uncertainties reports, the verification of supplier metrological procedures, participation to the assessment of Non-Conformities related to metrology, witnessing geometrical survey campaigns, carrying out independent geometrical surveys and participating to relevant project progress meetings; implementing reverse engineering techniques. New audit processes, oriented to product and process verification, have been conceived and implemented in close collaboration with F4E's Quality Assurance function. New techniques for metrology-guided assemblies are currently being implemented in the manufacturing of ITER components;
- **Materials and Fabrication Technologies:** Full-time support was provided to F4E's Project Teams to contribute to their activities in the scope of materials and fabrication technologies. The full-time support focused on coordination of the electron beam welding activities of the Vacuum Vessel sectors and follow-up of Blanket prototypes and procurement preparation. Furthermore, versatile support was given concerning a variety of joining technologies, examinations, materials testing and health & safety;
- Moreover, **specific activities related to the production of nuclear data** were carried out. Validated nuclear data for radiation transport and activation calculations are required to improve predictive capabilities in support of nuclear design activities.

Annual Objectives				
Milestone ID	**Scope Description**	**Forecast Achievement Date**	**Type of Milestone**	**End of December 2018 Schedule Status**
EU.ES.01.40600	F4E-OMF-0871: Framework Contract Signed for Engineering Support Contract	Q2 2018	WP18 objective	Achieved
EU.ES.01.42020	F4E-OMF-0878: Framework Contract Signed for Metrology Support Services of the ITER components	Q3 2018	WP18 objective	Achieved
EU.PM.3028010	TO.017 Lot 1 - Task Order Signed in Support of CM & SE Requirement Management Verification – Senior for RMV MDT and PTs implementation	Q4 2018	WP18 objective	Achieved
EU.PM.3051190	Framework Contract signed for risk management support	Q4 2018	WP18 objective	Not achieved. Framework Contract signed for risk management support was signed in January 2019.Resource priority given to Milestone ID EU.PM.3050930
EU.PM.3050930	Framework Contract signed for Project Performance Management support	Q3 2018	WP18 objective	Achieved
EU.PM.46540	Task Order Signed for TO 14 Lot 1 in Support of CM & SE – Senior #3 for SE Support to PTs	Q3 2018	WP18 objective	Achieved

Table 13: Supporting Activities – Annual Objectives presented in the F4E Work Programme 2018, Second Amendment.

1.3.3 Plasma Engineering

The Plasma Engineering group provides expert support and analysis to the ITER Project, and directly to F4E Project Teams and their suppliers, in plasma control, plasma scenario development, plasma-wall interactions and plasma operation. Plasma Engineering addresses the analysis and definition of requirements (including definition and verification of loads) coming from interfaces with the ITER plasma and is involved in the study of the impact of design changes on the ITER machine performance and operation.

The Plasma Engineering scope includes also carrying out specific activities requested by the ITER Organisation by means of ITER Task Agreements, supporting F4E managerial/strategic decisions, and interacting with technical and scientific committees advising F4E and the ITER Project.

1.3.4 Transportation

This activity reflects the management, on F4E's side, of technical aspects of the joint procurement with the ITER Organization for the transportation of ITER components to the site in Cadarache. The scope includes the transportation of large ITER components from all ITER Domestic Agencies, from the point

of entry (the port of Marseille at Fos or Marseille's Marignane Airport) to the ITER site as well as F4E technical support on transportation and logistics activities.

The main cost driver is transportation of Highly Exceptional Loads that follow the dedicated ITER itinerary. During 2018, this activity mainly covered transportation of some non-EU loads between Fos and Cadarache (EU-leg): Assembly tooling components supplied by the Korean ITER Domestic Agency (KO-DA) and cooling water piping from the Indian ITER Domestic Agency (IN-DA). Several Highly Exceptional Loads such as electrical transformers from the Chinese (CN-DA) and Korean ITER Domestic Agencies also arrived this year.

In 2018 the focus was put on the reduction of the number of Highly Exceptional Loads and the related number of convoys, this jointly with the ITER Organization, all ITER Domestic Agencies and the transport company that F4E has chartered. For example, a Highly Exceptional Load convoy carried four components instead of one, thus resulting in risk reductions and savings in terms of guarding, traffic sign removal, highway closures and crossing, railway crossing, police escort, deviation routing and surveyors. Two and three-component convoys were carried out and four Vacuum Suppression Tanks procured by the ITER Organization were transported consecutively, reducing mobilisation and de-mobilisation cost for barge and trailers. In November 2018 an amendment was signed to extend the duration of the ITER Organization Logistics Service Provider contract with Daher from 2020 up to 2024, in order to ensure continuity. During 2018, loads were delivered successfully and on time; risks were mitigated; and opportunities used productively, thus resulting in significant cost-savings.

1.4 Overall ITER Performance

1.4.1 ITER Schedule Performance

1.4.1.1 Background

A baseline **Overall Project Schedule (OPS)** for the ITER Project together with an **Overall Project Cost** and the associated estimate of resources covering the full period 2016-2035 were approved *ad referendum* by the ITER Council in 2016 and updated to include changes approved by the ITER Council in 2017. This updated schedule sets December 2025 as the First Plasma date, which independent assessors consider the **earliest possible technically achievable date**. This is because the schedule has no contingency for work on the critical path.

The lack of contingency in the schedule is one of the main challenges that F4E has to confront with the ITER project. Such a large, ambitious and complex project, with many first-of-a-kind components requiring advanced and diverse technologies, entails many risks that can materialise during manufacturing and assembly. Changes can be limited but not avoided altogether. Until ITER construction is over, the possibility of further schedule delays and cost increases cannot be excluded.

1.4.1.2 F4E's Schedule for the In-Kind Contributions to ITER

To meet the EU's international obligations towards ITER, F4E is responsible for providing components (including the buildings) "in-kind" representing 45 % of the nominal value of ITER under strict F4E quality and safety control. The schedule along with cost and risk are key aspects of project management and

control. It sets out the work to be completed and allows performance monitoring and control. It is therefore very important that the schedule has a solid basis and is regularly updated.

Based upon the updated ITER baseline, F4E's own top-level baseline (Figure 18), known as "Level 0", outlines the most important ITER and F4E activities. Both the EU Vacuum Vessel sectors and nuclear buildings remain on the critical path, with the Toroidal Field coils close to the critical path. As noted earlier, with no contingency on the critical path, the schedule remains very challenging.

F4E's top-level schedule is underpinned by 60 comprehensive lower level **Detailed Work Schedules (DWS)** encompassing approximately 65 000 individual activities. These DWS are used by F4E for working-level schedule management. They have each evolved over time in terms of maturity, granularity, interface detail and scope.

Furthermore, the ITER Organization's Overall Project Schedule is supported by a detailed Master Schedule that is configuration-controlled by the ITER Organization and the Domestic Agencies (DAs). The Master Schedule forms the basis for project-wide performance monitoring and controlling by individual technical teams. The Master Schedule is based on the monthly submission and integration of DWS provided by the ITER Domestic Agencies This is a process whereby ITER receives the DWSs each month from the ITER Domestic Agencies and links them together to provide a consistent status for the whole project.

A "rolling wave" approach is used to allow the detailed schedules to be continuously refined over time. In the early stages, an indicative duration is foreseen in the schedule for each project, but, once a procurement starts and its scope is assigned to a supplier, the scheduling becomes more detailed thanks for the inclusion of the information provided by the supplier into the DWS.

The result of the above is that during the last five years the content, structure and therefore the reliability and effectiveness of the schedules has been improved.

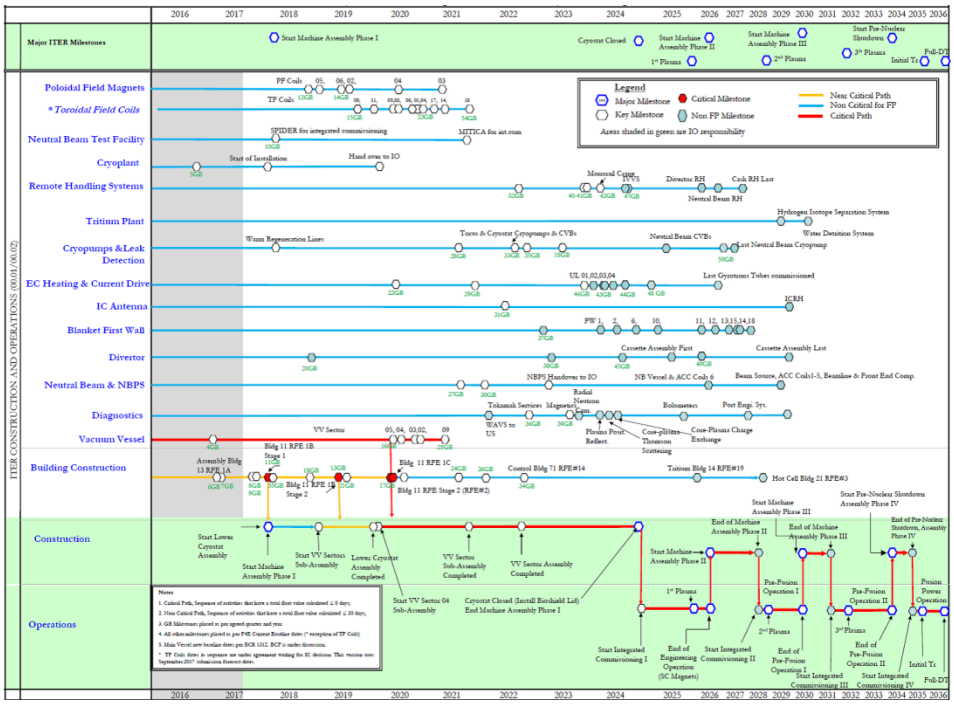


Figure 18: F4E Top Level schedule for ITER up to the Deuterium-Tritium Operation Phase in 2035 (critical path shown in red)

1.4.2 ITER Schedule Performance

In 2016, the ITER Council approved a set of high-level monitoring milestones for the period 2018-2025, which track the overall progress of the project. To supplement the ITER Council (IC) milestones, F4E's Governing Board approved additional milestones. In 2018, F4E delivered six of the seven planned **ITER Council or Governing Board milestones**:

1. Buildings: Completion of Tokamak Concrete crown civil works;
2. Buildings Civil works and finishing performed in B2 level allowing TB04 installation to begin in tokamak building B2 level;
3. Buildings: First limited access to Tokamak pit for installation without large crane availability (RFE 1B stage 1);
4. In-vessel: Delivery of the first all-Tungsten prototype test assembly of the Divertor Inner Vertical Target to the Radio Frequency test facility;
5. Neutral Beam Test Facility (NBTF): Start of integrated commissioning of SPIDER beam [Neutral Beam Heating];
6. Cryostat: Cryostat support bearings full-scale prototype delivery to site[6].

Achievement of these milestones represent clear tangible progress towards First Plasma for the systems within the F4E responsibility.

One ITER Council milestone related to the Buildings did not achieve the target date in 2018:

7. Building: Assembly building complete.

With common agreement of the ITER Organization and F4E, this milestone was delayed to prioritise resources to more urgent construction works. This delay is not expected to have any impact on the project critical path, while risks associated with the co-activity it will generate will be managed by the Construction Management-as-agent (CMA) under contract with the ITER Organization. Currently this milestone is expected to be met by early 2020.

By end-2018, F4E had achieved 14 out of its 15 ITER Council or Governing Board milestones since 2016. At the overall ITER Project level, 38 ITER Council milestones were achieved (by F4E, the other six ITER Parties and the ITER Organization). This testifies to the continued improvement in project performance since the reforms made to the project in 2015.

F4E regularly reports on the status of those milestones via monthly reports, tracks the risks of not achieving them and, where necessary, implements recovery actions to mitigate any forecasted delays.

In 2018 the ITER Organization announced that the overall project had reached 60 % of the total construction work scope to First Plasma against a planned value of 68 % based on ITER's project performance metrics, including design, component manufacturing, building construction, shipping and delivery, assembly, and installation. Including all post First Plasma construction work to achieve D-T, the ITER project execution reached 47 %.

[6] Activity performed by the ITER Organization within the BIPS Team led by F4E

The ITER Project's critical and near critical paths continue to pass through the Tokamak Buildings, Vacuum Vessel Sectors, In-Wall Shielding, and Toroidal Field coils, with building availability and transversal engineering works place the Tokamak Complex installation on the very near critical path.

The ITER Organization and Domestic Agencies including F4E, continue to commit to the Overall Project Schedule and First Plasma in 2025. This commitment is based on gaining an improved understanding of the time required for first-of-a-kind manufacturing, combined with available project float, and additional actions by both the ITER Organization and Domestic Agencies/supplier to reduce the cascade delay on the assembly works. This commitment will be confirmed through detailed monitoring of manufacturing, and assessment in the coming months.

1.4.3 F4E Schedule Performance

In addition to the ITER Council and Governing Board high-level milestones described in the previous section, F4E uses a basket of **internal milestones** to monitor more precisely its own performance. Comparing the actual delivery of these milestones against the plan allows F4E to derive a Schedule Performance Index (SPI). F4E has provided this Key Performance Indicator in previous reports and Figure 19 shows how it has evolved since 2014.

F4E's achievement of a SPI of 93 % in 2018 is maintaining the improvements seen in 2017. F4E attributes this to the ongoing focus on schedule performance by its staff as well as continuously improving project management processes, methodologies and tools, as described in the following chapter. F4E have devoted more effort to ensure that planning for milestone execution is regularly updated under change control processes.

While milestone counting provides simple "snapshot" statistics, it does not reveal underlying trends in work progress. For this, F4E places more emphasis on the **Milestone Trend Analysis (MTA)** method. F4E started using MTAs in 2016 to objectively visualise the evolution of milestones in time and identify trends that may indicate possible future slippages as early as possible.

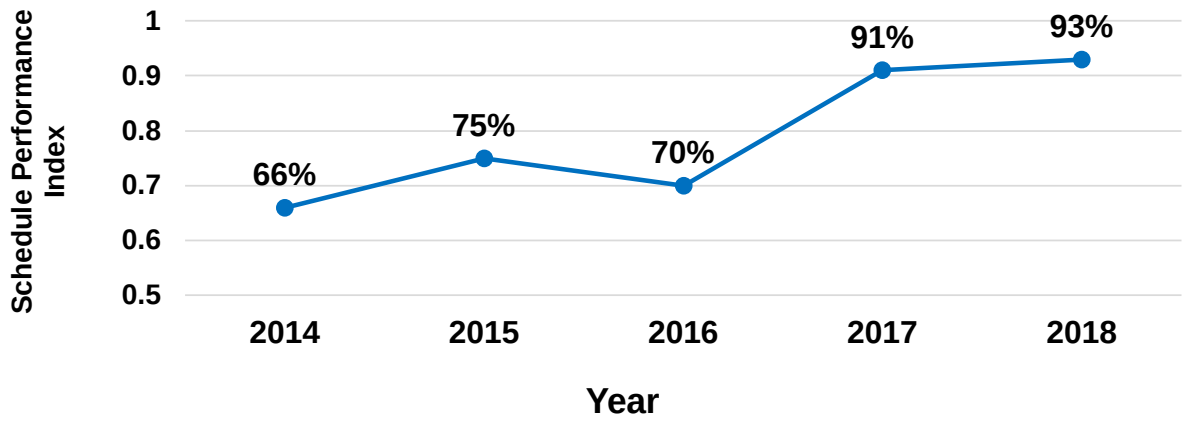


Figure 19: F4E's Schedule Performance Index for 2014-2018. (100 % means achievement of all planned milestones)

1.4.4 F4E Performance by Earned Value

While milestone analysis provides indications of performance, it does not take into account the importance of milestones. This is why F4E also employs **Earned Value Management** using the so-called 'ITER credits'.

The ITER Organization and each Domestic Agency agree a credit profile as part of each Procurement Arrangement to measure the value achieved as the work progresses. Credits provide a clear indication on the progress achieved by F4E in discharging EU obligations for the supply of in-kind components to the project. Figure 20 shows, compared with the baseline, both the achieved credit and the amount formally released up to now by the ITER Organization through its financial system as formal acknowledgement of the delivery.

The difference between achieved and released credit is due to the timing of F4E credit request after the achievement of milestones as well as the time for the formal acceptance by ITER of the deliverable and all associated documentation which can be a lengthy process.

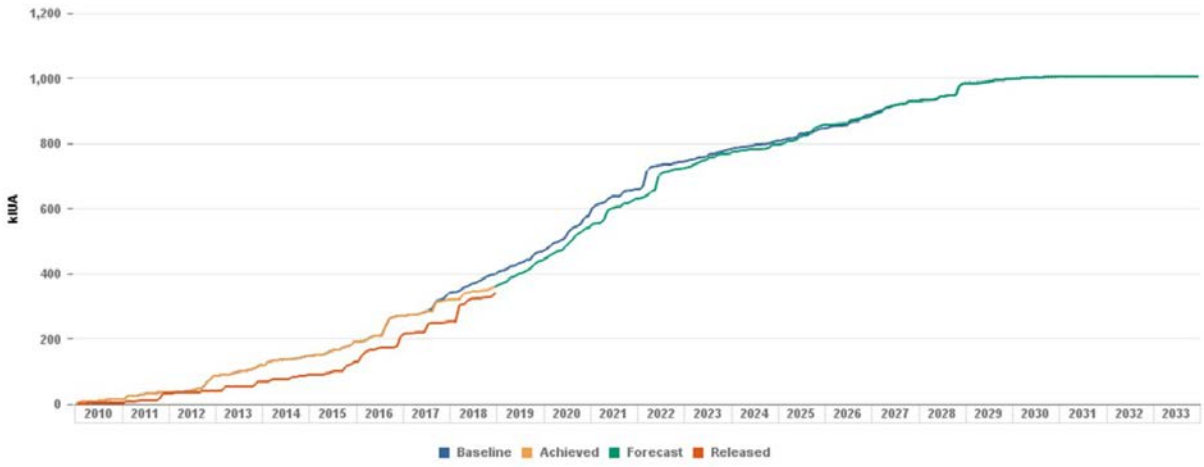


Figure 20: Comparison of the planned/achieved/released ITER Credit over the project lifetime

The discrepancy between the achieved and planned value of ITER credit in 2018 is due in significant part to the re-planning of work carried out with the ITER Organization known as the "Revised Construction Schedule". In addition, there have been some adjustments of credits both in total value and in profile following specific agreements with the ITER Organization.

The overall progress of work for all of F4E's in-kind contributions to ITER can be determined to have reached 41 % of all signed Procurement Arrangements and 37 % of all Procurement Arrangements by the end of 2018. This appears to be modest but it is important to note that for the Procurement Arrangements signed in early years of the project (i.e. the Toroidal Field and Poloidal Field coils, and Vacuum Vessel) the ITER Organization attributes a greater proportion of ITER credit to deliverables in later phases of projects, in particular, the delivery of completed components.

1.5 Broader Approach Projects Performance

Contributions to Broader Approach projects are formalised under Procurement Arrangements between F4E and the Japanese Implementing Agency (QST), which in turn are backed by Agreements of Collaboration between F4E and institutions chosen by the Voluntary Contributors. F4E contributes through its own budget to quality assurance, transportation of components to Japan, integration, and, to a limited extent, procurement for EU contributions not covered by the Voluntary Contributors. The accounting of contributions is tracked by an **Earned Value Management** approach using credits (Broader Approach Units of Account). The three Projects use as key performance indicator the ratio of credit awarded under the Broader Approach Agreement to credit planned at that date (Figure 21).

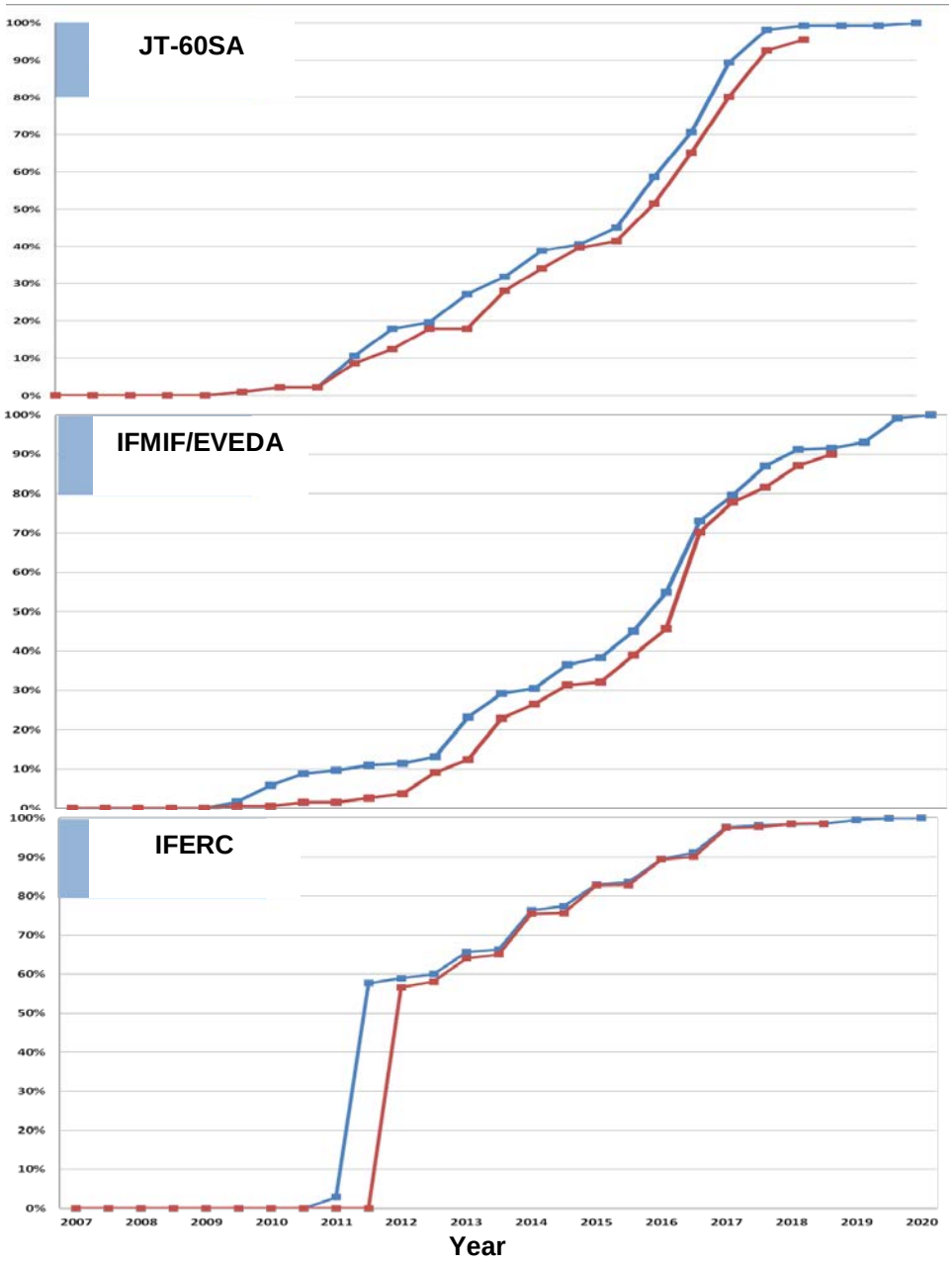


Figure 21: Earned Value for the three Broader Approach projects showing awarded (blue with markers) compared with planned (black line)

Part II. (a) Management

2.1 Governing Board

Here follows an overview of the significant main elements discussed at the F4E's Governing Board and significant items approved or decided by this body.

Meetings

F4E`s Governing Board met on three occasions during 2018, preceded by five Bureau meetings in total, having as main objective the review of key documents and the proposal of recommendations on Governing Board decisions.

The summaries of the meetings of the Governing Board are made public and accessible via F4E`s external website: http://www.fusionforenergy.europa.eu/aboutfusion/meetings.aspx

F4E Progress

The Governing Board welcomed the good progress and achievements of F4E both on the ITER Project and in the Broader Approach Projects.

Governance

The Governing Board adopted the proposal concerning the improvement of F4E`s Governance Efficiency in its July meeting and thanked the Working Group on Governance Improvement for its excellent work. The Governing Board adopted the amended Procurement and Contracts Committee (PCC) rules of Procedure and agreed to enlarge the Bureau with three additional members. There was also agreement to implement measures to simplify Governing Board meetings so that the Governing Board could concentrate on strategic discussions: standardised executive summaries, information dashboard, precise timing of documents delivery and a larger role of the subcommittees, Administration and Management Committee, Technical Advisory Panel and Audit Committee, in pre-discussing Governing Board agenda points.

Annual Assessment

The Governing Board endorsed an action list following F4E`s sixth annual assessment recommendations in its extraordinary meeting in March.

The Governing Board agreed to launch F4E`s seventh annual assessment by an external expert group in order to assess the progress of ITER with a focus on performance and project management, including cost containment, schedule project control as well as risk management in its July meeting. The conclusions were presented in the December meeting and the Governing Board welcomed the overall positive assessment whilst requesting F4E to prepare an action plan to respond to the assessor´s report. The Multi-Annual Programming Ad Hoc Group was tasked to review this action plan and monitor its progress.

ITER Buildings

The Governing Board endorsed both the TB03 negotiation strategy and the proposal for a budget cap on the whole contract in its July meeting.

The Governing Board also endorsed the novation for the TB04 installation activities in the Tokamak Complex to the ITER Organization in its July meeting.

The Governing Board welcomed the reports of the Buildings Ad Hoc Group and requested F4E to prepare an action plan in response to the recommendations, to be followed up by the Bureau and presented to the extraordinary meeting in April 2019.

The Governing Board welcomed the positive report from the Procurement and Contract Committee on the TB03/TB04 contracts amendments.

Nuclear Safety

The Governing Board endorsed the action plan developed following the recommendations of the Nuclear Safety Ad Hoc Group (AHG) in its July meeting and acknowledged the good work of the AHG.

Nuclear Beam Test Facility (NBTF)

The Governing Board welcomed the positive report on the project status in its December meeting and thanked the NBTF Ad Hoc Group (AHG) for the excellent work.

The Governing Board requested F4E to prepare an action plan in response to the recommendations made by the AHG, to be followed up by the Bureau and presented to the extraordinary Governing Board meeting in April 2019.

Project Planning and Budget

The Governing Board welcomed the positive opinion expressed by the European Commission and adopted the Multi-Annual Programming document 2019-2023.

The Governing Board adopted the 1st and 2nd Amendment to the 2018 Work Programme.

The Governing Board adopted the 1st and 2nd Amendment to the 2018 Budget and adopted the 2019 Budget.

Annual Reports and Accounts

The Governing Board adopted the 2017 Final Annual Accounts and the Analysis and Assessment of the 2017 Annual Report.

Audit matters

The Governing Board approved the Internal Audit Service Mission Charter in its extraordinary meeting in March, approved the revised Internal Audit Capability Annual Plan in its July meeting and approved the Internal Audit Capability Annual Plan 2019 in its December meeting.

2.2 Major Developments

2.2.1 Introduction

During 2018 F4E has consolidated the F4E "turnaround" programme aimed at improving its performance and management:

- Of the 15 pending actions in F4E's 2017 Action Plan, six were implemented by F4E bringing the total to 82 % by end-2018 (72 % including 11 new actions following the 2018 Council Conclusions);
- F4E signed 77 contracts and grants in 2018 for a total value of € 173m, as well as € 273m of amendments to existing contracts, increasing the total investment by F4E to nearly € 5bn – the balance to the budget being executed for in-cash contribution amounting to € 193m and administrative expenditure amounting to € 56m.
- F4E continued to implement the nuclear safety improvement action plan, with several actions taken to response to improve the management of nuclear safety and raise the nuclear safety culture;
- F4E implemented 98.4 % of commitment appropriations (99.9 % individual) and 96.1 % of payment appropriations, giving some confidence in the improved robustness of the project planning;
- F4E's action implementation rate in response to recommendations of the internal auditor remained high at 79 %.

2.2.2 F4E's Action Plan

F4E, in agreement with its Governing Board, has been implementing actions to improve the performance of the project. The first actions from 2015 were complemented by actions: (a) in 2016 at the Director's initiative, (b) for the 2017 assessment and (c) for the 2018 Council Conclusions on the reformed ITER project[7].

Of the 15 pending actions at the time of the 2017 edition of this report, F4E implemented six by the end of 2018 bringing the total from 77 % to 82 % by end-2018 (excluding actions added in 2018).

[7] *Council conclusions on the reformed ITER Project 7881/18 12 April 2018*

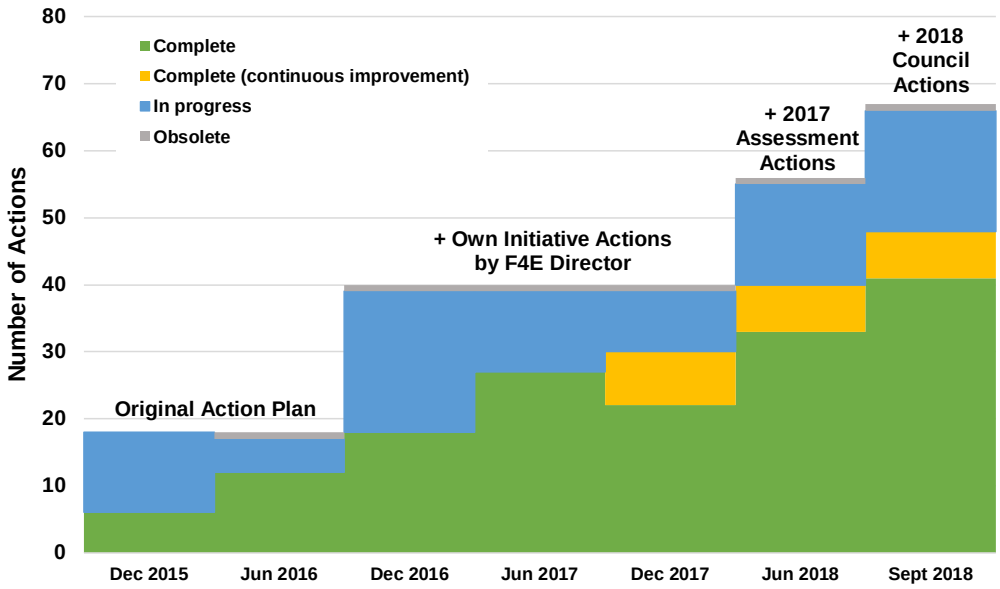


Figure 22: Evolution of the implementation of F4E's corporate level actions since 2015

2.2.3 Management Systems

Project Management is an aspect that F4E has continued to reinforce and improve throughout 2018. The functioning of the monthly **Project Steering Meeting**, at which the status of F4E's projects are reviewed, was improved during 2018 with new reporting templates and greater focus on resolution of issues and effective decision-making.

An industry standard **Enterprise Project Control System (EPC)** known as EcoSys® was implemented by F4E in 2017 and consolidated during 2018 with introduction of all payment profiles. The system allows a better control of the financial environment, including the cost estimate at completion, budget allocation, commitment and payment forecasts with links to ABAC (F4E's accounting system), PRIMAVERA® (F4E's schedule management system) and the Integrated Reporting System (SAP Business Warehouse®). It replaces a number of operative spreadsheets prone to error.

The **Integrated Reporting System (IRS)** now allows F4E Management and staff access to high quality, consistent reports combining data from different sources (i.e. accounting [ABAC], scheduling [PRIMAVERA®] and now the EPC). Users can filter the data live within the Integrated Reporting System and drill-down reports when required. In 2018 the number of Integrated Reporting System reports was extended and the quality of Milestone Trend Analysis improved. In addition, F4E continued to roll out a new 'dashboard' showing the most important Key Performance Indicators (KPIs) which is not only used for monthly reporting to the Project Steering Meeting and stakeholders but also shown on screens located on every floor of F4E's offices at the Barcelona HQ. This ensures staff are aware of the project performance during the last month.

Evolution of the **Cost Estimate at Completion (EAC)** at Level 6 of F4E's Work Breakdown Structure (i.e. contract level) was updated throughout 2018 according to the evolution of the activities. The system continues to be improved and it is now more user-friendly and reliable with cost risk impacts in the PRIMAVERA® Risk Register. F4E reviewed the EAC each month during in the Project Steering Meetings and through specific deep-dive meetings in each of the project areas. In addition, F4E acted

in full transparency by providing reports on the EAC to each meeting of F4E's Governing Board with waterfall graphs showing the sources of any changes from the previous meeting.

F4E and its contractors continue to consistently use the **Contract Management Platform** to support the planning, execution and monitoring phases of contracts. This is closely linked to the DACC (Deviations Amendments and Contract Changes) tool, used by F4E to process deviations, contract changes, amendments and commercial activations. During 2018 a number of improvements were made to DACC with the aim of further improving the control of excess costs of ongoing contracts and the efficiency of the management process by decreasing the time for the approval of changes. With DACC, the process for the authorisations of deviations is paperless and reduces the risk of error as evidenced by the reduced number of exceptions.

The **Improvement Steering Committee (ISC),** set up in 2016, has proven its ability to align management views on improvement priorities and objectives, ensuring that the appropriate resources and conditions are in place to successfully achieve what is intended. In 2018 F4E consolidated the '**Lean Six Sigma**' methodology[8] aimed at making processes in F4E more efficient and effective. F4E also adopted a **Business Process Management (BPM)** frame to reinforce process development. In 2018, F4E completed four improvement projects:

1. 'Integrating F4E Change Control' reinforced the mechanism to thoroughly track all types of changes (scope, cost and schedule) and assessment of interrelated impacts;
2. 'Lead time on operational procurement' streamlined the activities from the launch of a call to the contract signature reducing the number of days for the open procedure up to € 2m;
3. 'Financial and operational roles and responsibilities in the approval flow' split into three subprojects (Procurement Arrangement, Contract management and Costing activities);
4. 'Document Management' efficiently addressed audit recommendations on the subject.

Three other projects were monitored to ensure the expected objectives were achieved:

5. 'Financial Planning Tool' (Ecosys);
6. 'Mechanism of EAC';
7. The DACC Tool project which manages deviations, amendments and contract changes;

Two other projects were being implemented or rolled out:

8. 'Improve Recruitment and Selection' project identified a series of improvement actions which were tested in a pilot phase with good results and will now be rolled out;
9. An improvement plan to address the key root causes for the project 'Reduce Schedule Delays' project was started in 2018 and will provide its conclusions in 2019.

2.2.4 Nuclear Safety

Nuclear safety is a priority for F4E and is one of its top Corporate Objectives. The nuclear operator in the ITER project is the ITER Organization, which is the unique interface with the French Nuclear Safety

[8] *A set of techniques and tools for process improvement*

Authority (ASN) and propagates the safety requirements to F4E and the other ITER Domestic Agencies, who in turn propagate to their suppliers and control their correct implementation.

Following the Technical Advisory Panel Ad-Hoc Group report and the ASN inspection of 2017, an extensive action plan for developing the nuclear safety and its culture in F4E was presented to the Technical Advisory Panel and Governing Board in June and July 2018, and the Governing Board "expressed satisfaction that a Nuclear Safety (NS) action plan including all the AHG recommendations has been presented".

The first corrective actions, answering to the request for higher F4E organisation concerning nuclear safety, have been implemented in January 2018 through increased missions to the Nuclear Safety Team and its transfer to the Project Management Department.

In 2018, the F4E Nuclear Safety Team continued to support the F4E Project Teams by providing expertise in the field of nuclear safety required during design and/or manufacturing of Protection Important Components, and also provided an increased assurance to F4E Management through independent nuclear safety inspections on F4E suppliers' or F4E teams' activities. Additionally, F4E carried out training actions and also actions in relation to the nuclear safety culture.

In 2018, external experts have finalised an extended assessment of the nuclear safety culture within F4E, following an IAEA methodology. This study has identified several work streams for improvements, and will trigger a complement of the Nuclear Safety action plan currently ongoing.

2.2.5 Quality Assurance

Quality Assurance (QA) at F4E covers QA and Quality Control (QC) activities, QA focuses on providing confidence that quality requirements are fulfilled and QC focuses on fulfilling quality requirements. In 2018 the main QA activities were to:

- Support the Project Teams on QA and QC topics ensuring that the F4E Integrated Management System (IMS) is implemented through the supply chain and advising them on quality matters;
- Define, coordinate, develop & implement Quality Programmes, the general Supplier Project Management and Quality Requirements, including the annual Supplier Audit Programme and relations with the ITER Organization's quality representatives for quality issues;
- Perform 23 audits of suppliers of which 16 were found to be meeting standards, two were above and five below;
- Reduce by 70 % the number of open Non-Conformity Reports (NCRs) in 2018 compared to 2017 (Figure 23). At the same average time to close NCRs was 168 days, well below the requirement of 270 days.

The main QC activities implemented during 2018 were to:

- Monitor the quality of the deliverables and processes is being met and detecting defects by using the established tools, procedures and techniques;
- Perform 25 supervision visits by the assigned Quality Officer within the F4E supply chain;
- Manage the 27 on-site external inspectors located in the main workshops around Europe for the Vacuum Vessel, Magnets and Neutral Beam.

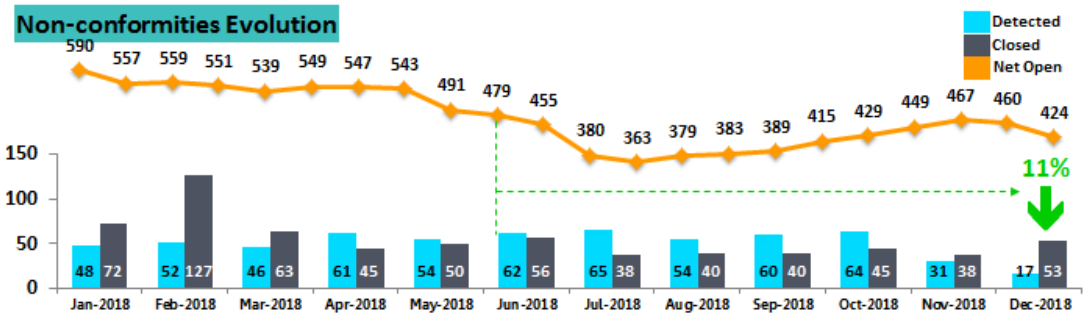


Figure 23: Evolution of the number of NCRs during the course of 2018

2.3 Budgetary and Financial Management

The 2018 financial statements and the budget implementation are detailed in the 2018 Final Annual Accounts, attached to the present Annual Activity Report (Annex VII. Final Annual Accounts) and in the 2018 Budgetary and Financial Management Report, published separately.

2.3.1 Establishment of the 2018 Budget

F4E 2018 budget was initially adopted by F4E's Governing Board[9] for the amount of € 610.93m in commitment appropriations and € 634.12m in payment appropriations.

It was successively amended in the Governing Board meetings of June and December 2018 Governing Board meetings.

The final available budget was € 686.54m in commitment appropriations and € 830.93m in payment appropriations.

2.3.2 Contributions to the 2018 Budget in Revenue

The distribution of the 2018 revenue ensures a fair balance between contributors, in line with their relative contribution for the overall period of ITER construction (the detailed figures are provided in Annex II. b. Statistics on Financial Management Budget – Evolution of the Budget):

[9] *Decision of the F4E GB F4E(17)-GB39-5.6 adopted on 01/12/2017*

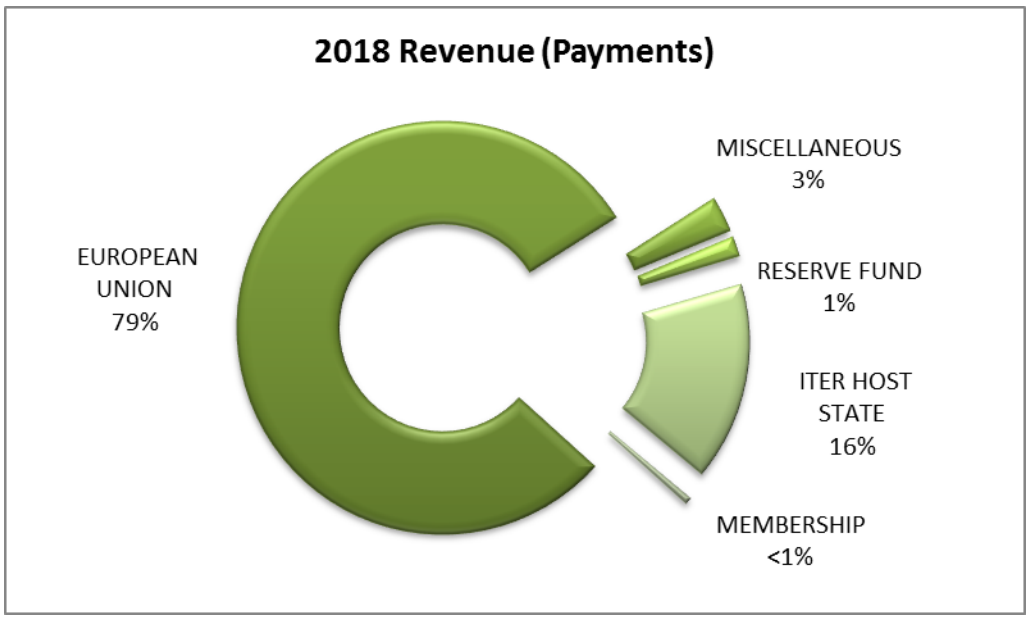


Figure 24: 2018 revenue (Payment)

The final statement of revenue was almost entirely cashed, including the outstanding revenue from the previous year. Only a small amount was still due at the year-end, corresponding to the membership contribution of Spain, amounting to € 0.12m.

2.3.3 Implementation of the 2018 Budget

Revenue	100.0%	of the revenue was collected		
	Revenue : 831.31		Cashed: 831.18	EUR million
Commitments	98.4%	of Implementation of the final available budget		
	Final Budget: 706.23		Execution: 694.99	EUR million
	113.8%	compared to the original budget		
	Original Budget: 610.93		Execution: 694.99	EUR million
	99.9%	in individual commitments		
	Execution: 694.99		Ind.Commit.: 694.53	EUR million
Payments	96.1%	of implementation of the final available budget		
	Final Budget: 847.37		Execution: 813.99	EUR million
	128.4%	compared to the original budget		
	Original Budget: 634.12		Execution: 813.99	EUR million

Figure 25: Commitments and Payments

2.3.3.1 Implementation of the 2018 Administrative Expenditure

The permanent monitoring of the administrative requirements allows reaching a fair balance between the actual needs and the budget. An increase of the administrative expenditure was required, due to the following elements (see Annex II. b. Statistics on Financial Management Budget – Evolution of the Budget):

- Salaries: Compared to the initial draft budget established in the 2016 edition of the Resource Estimates Plan, the additional needs were mainly due to the new trend of positive adjustments of salaries since 2017 while the vacancy rate was maintained at low level all along the year 2018.
- Missions: The number of missions in the frame of the follow-up the manufacturing contracts has been maintained, in order to take into account the recommendations of F4E's Management Assessors, as endorsed by the Governing Board (i.e. F4E staff should be more present at the manufacturing sites).

The additional needs were provided by an additional contribution from Euratom and the balance by transfers adopted by the Director according to Article 27 of F4E Financial Regulation. Annex II. Statistics on Financial Management provides the detail of the transfers. The entire administrative budget was committed and 88.5 % was paid at the end of the year.

2.3.3.2 Implementation of the 2018 Operational Commitments

The statement of operational expenditure, developed in Annex II. Statistics on Financial Management was modified with two amending budgets in June and December 2018 in order to reflect the changes in the statement of revenue and to align the operational budget in commitment appropriations, with the successive amendments to the 2018 Work Programme. 99.9 % of the budget was implemented in individual direct commitments.

2.3.3.3 Implementation of the 2018 Operational Payments

The statement of operational expenditure, in Annex II. Statistics on Financial Management was modified with two amended budgets in order to reflect the changes in the statement of revenue. Transfers within the Title 3 were adopted by the Director according to needs at the year-end to ensure a complete final implementation.

The final implementation rate for operational payment was 96.6 % at closure, representing € 26.4m of non-executed payments. The final implementation was indeed limited by the available treasury, considering the re-coverable VAT amounted to € 27.9m at the end of 2018, mainly related to works contracts at Cadarache.

2.3.4 Impact of the 2018 Budget in Commitment

2.3.4.1 Main Commitments

The main operational commitments for the 2018 budget are:

- € 193.25m for the in-cash contribution to the ITER Organization;

- € 169.36m for the contribution to assembly installation and related services for the TB04 contract (building)
- € 81.80m to fund additional scope, quantities and complexity increases for the TB03 contract (Building);
- € 22.45m for the supply of the beam source for the MITICA experiment (Neutral Beam)
- € 21.62m for the fabrication of a standard cassette body (in-vessel);
- € 145.06m in about 530 commitments for smaller contracts.

2.3.4.2 Action Extending for More than One Financial Year

The entire operational budget of F4E is in dissociated appropriations and more than 500 open commitments from the 2018 budget amounting to € 381.88m cover actions extending for more than one financial year (final date of implementation after 31 December 2018).

2.3.4.3 Actions Carried Forward to 2018

The F4E obligations amount to € 1 552.64m at the closure of the 2018 budget. It corresponds to the total amount left over on open budgetary commitments, including global commitments from the 2018 budget, and is detailed as follows:

(EUR)

2018 budget Heading	Open Commitments beginning of 2019				
	from previous year (1)	from 2018 budget (2)	Total (3)=(1)+(2)	To be de-committed (4)	Net Total (5)=(3)-(4)
TITLE 1 - STAFF EXPENDITURE	**0.00**	**2 128 019.15**	**2 128 019.15**	**0.00**	**2 128 019.15**
TITLE 2 - OTHER OPERATING EXPEND.	**53.36**	**3 333 779.19**	**3 333 832.55**	**53.36**	**3 333 779.19**
Total TITLE 1 & 2	**53.36**	**5 461 798.34**	**5 461 851.70**	**53.36**	**5 461 798.34**
CH 31 - ITER CONSTRUCTION INCLUDING ITER SITE PREPARATION	796 904 040.05	213 193 134.37	1 010 097 174.42	69 896 267.55	**940 200 906.87**
CH 32 - TECHNOLOGY FOR ITER	4 585 887.19	8 965 796.05	13 551 683.24		**13 551 683.24**
CH 33 - TECHNOLOGY FOR BROADER APPROACH AND DEMO	9 330 072.29	1 922 042.70	11 252 114.99		**11 252 114.99**
CH 34 - OTHER EXPENDITURE	2 257 789.97	4 162 535.78	6 420 325.75		**6 420 325.75**
CH 35 - ITER CONSTRUCTION - APPROPRIATIONS ACCRUING FROM THE HOST STATE CONTRIBUTION	180 369 392.28	152 228 753.15	332 598 145.43		**332 598 145.43**
CH 36 - APPROPRIATION ACCRUING FROM THIRD PARTIES TO SPECIFIC ITEM OF EXPENDITURE	2 364 216.61	3 093 575.65	5 457 792.26	44 234.81	**5 413 557.45**
Total TITLE 3	**995 811 398.39**	**383 565 837.70**	**1 379 377 236.09**	**69 940 502.36**	**1 309 436 733.73**
Total	**995 811 451.75**	**389 027 636.04**	**1 384 839 087.79**	**69 940 555.72**	**1 314 898 532.07**

Table 14: Open budgetary commitments at the closure of F4E's 2018 budget

The F4E obligations amount to € 1 314.90m at the closure of the 2018 budget.

The total amount of open commitments is decreased by € 237.70m compared to the situation at the end of 2017[10].

Notes:

- Administrative expenditure carried forward from 2017 and not paid were cancelled;
- Title 1: There was no leftover on the 2018 commitments related to direct staff cost, normally cancelled at the end of the current year. The balance as shown in the table above corresponds to other expenses linked to staff: missions, interim staff, schooling, training, etc. for which the commitments are carried over for one year;
- Title 2: The commitments are carried over and should be consumed at the latest by 31 December of the following year;
- Title 3: The open operational commitments are carried over to the following year with no limitation in time, but to be paid according to the advancement of the contracts.

2.3.5 Interest Charged by Suppliers through Late Payments

During 2018 F4E has processed 2 499 payment transactions (excluding salaries). This amounts to a decrease of 1 % in comparison with 2017. Payments of invoices falling under Title 3 (operational expenditure) increased by 6 % over 2017. The implementation of the electronic workflow for payments in the previous years has shown a significant increase in efficiency. F4E paid € 4 452 of late interest in 2018.

2.3.6 Procurement Procedures in 2018

In line with the focus that F4E has on First Plasma achievement, the procurement procedures continued in 2018 to progress in the design and prototype manufacturing phases of the systems and components belonging to the EU in-kind obligation.

Hence, during 2018 a total of 55 operational procurement procedures were launched and 69 procurement contracts were signed for a value of approximately € 162m, while a total of one grant procedure was launched and two were signed.

On the administrative side, in 2018 a total of 12 administrative procurement procedures were launched by F4E and 6 procurement contracts (direct or framework) were signed, with a budget of € 11m.

[10] *F4E(17)-GB38-16.1 2017 Final Annual Accounts*

2.3.6.1 Type of Operational Procurement Procedures

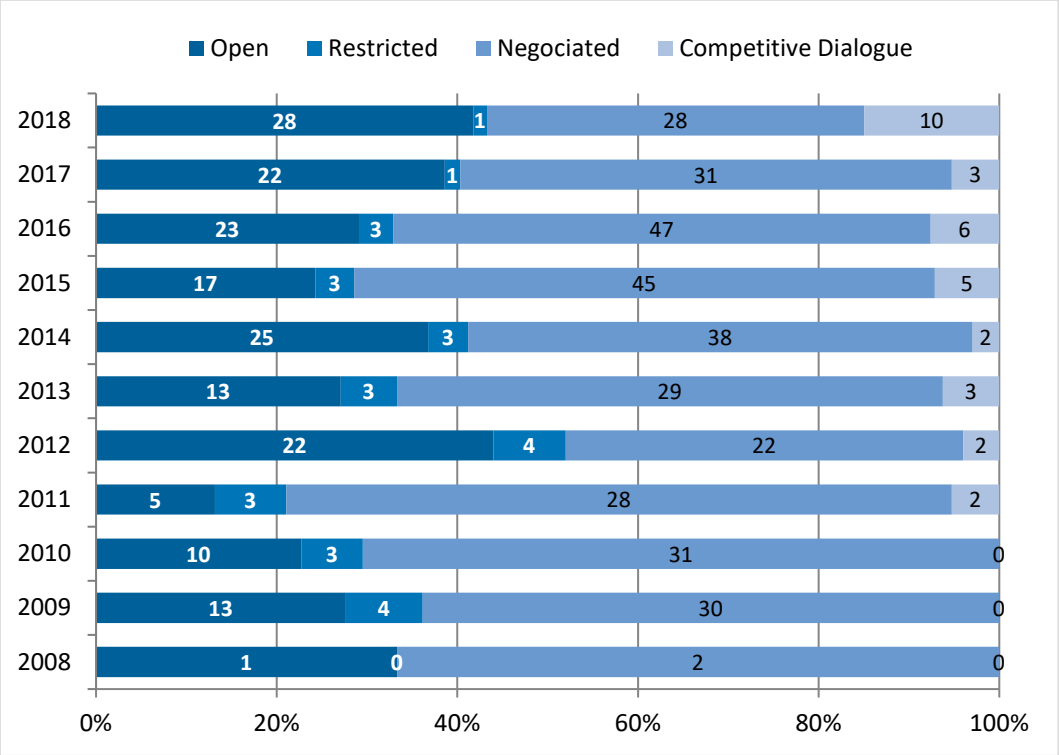


Figure 26: Contracts awarded by procurement procedure (Number and annual share)

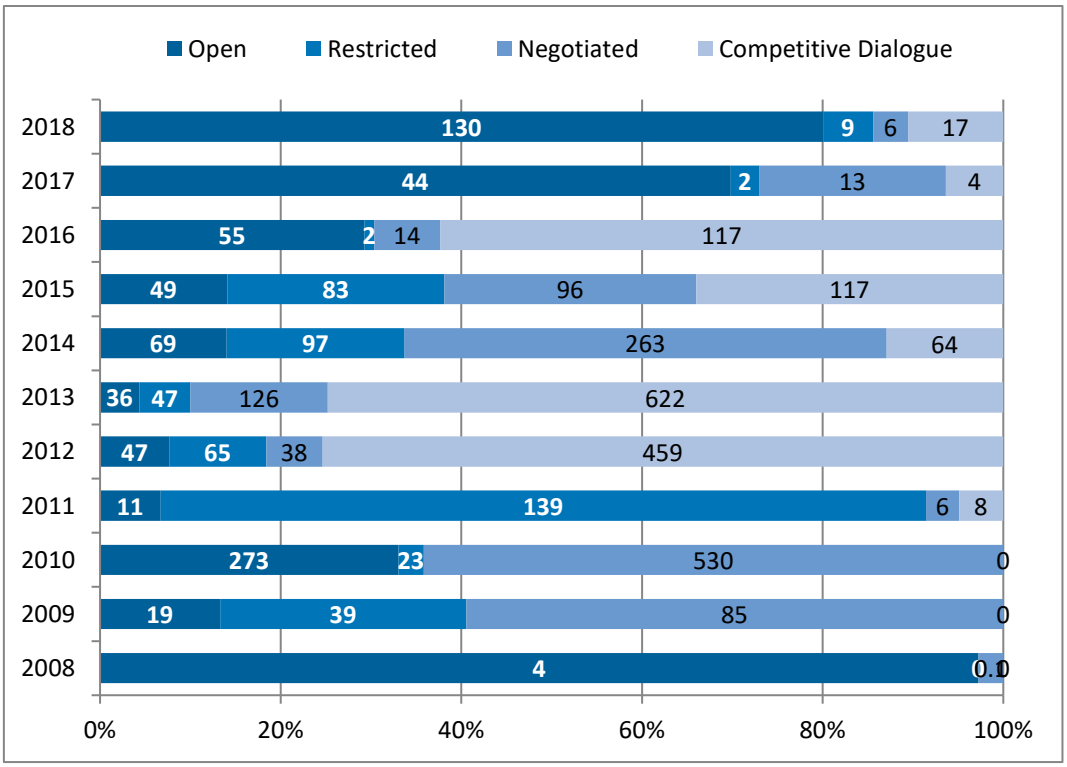


Figure 27: Contracts awarded by procurement procedure (€ million and annual share)

2.3.7 The 2018 and Previous Budgets

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

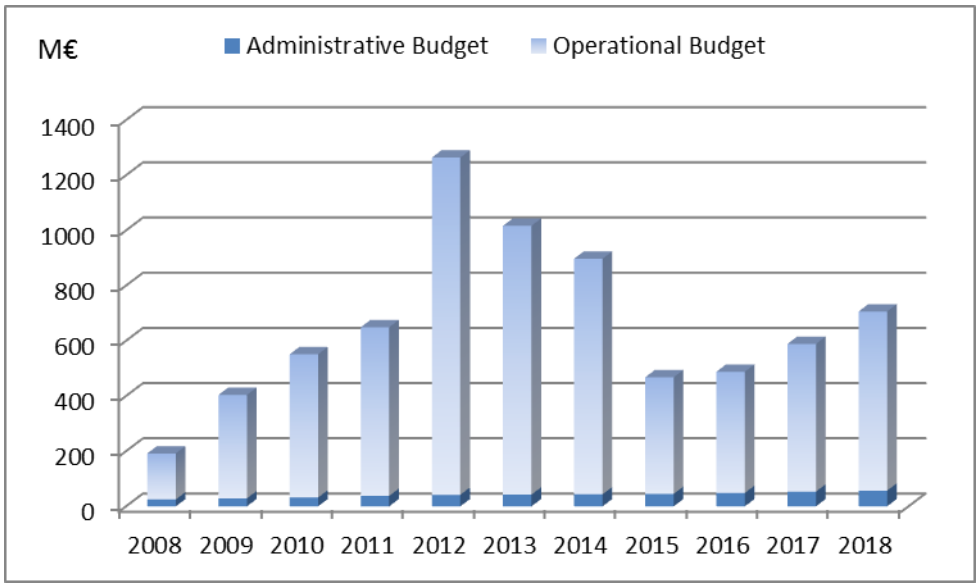


Figure 28: Evolution of the Budget in commitment appropriations since 2008

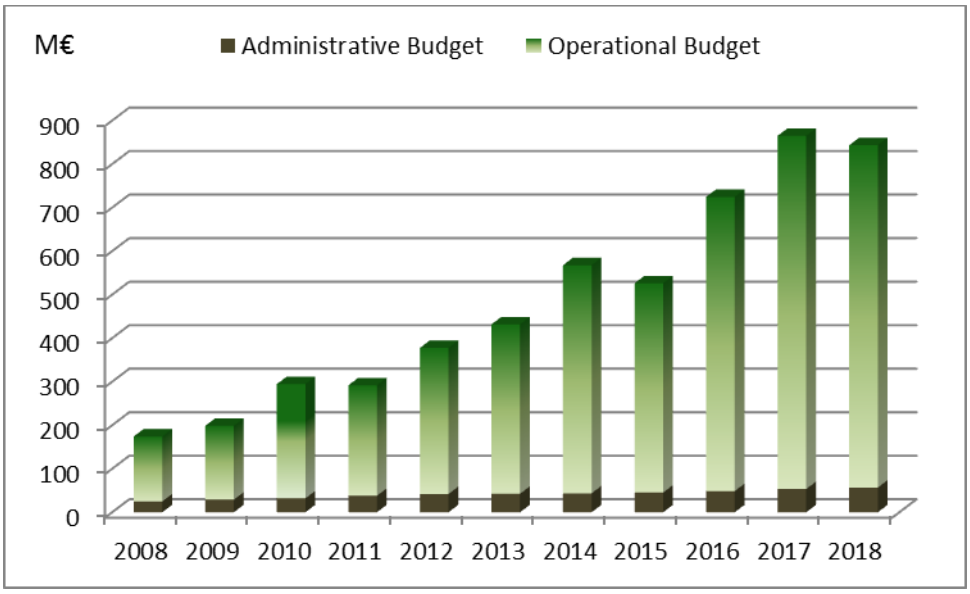


Figure 29: Evolution of the Budget in payment appropriations since 2008

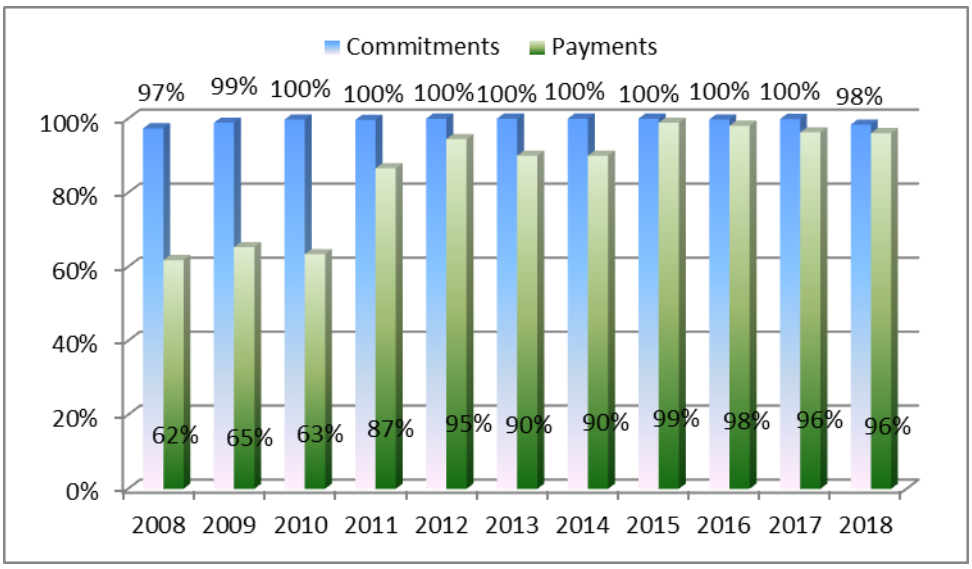


Figure 30: Evolution of the performance of implementation of the Budget since 2008

2.4 Budget Implementation Tasks Entrusted to Other Services and Entities

There are no F4E activities delegated to other European Institutions or Bodies.

2.5 Human Resources (HR) Management

2.5.1 Major HR Developments

Specifically, some of the main actions undertaken include:

Staff Evolution, Selections and Recruitment

As of 31 December 2018, the occupied posts at F4E included 51 Officials, 226 Temporary Agents, 168 Contract Agents[11] and one Seconded National Expert. In addition, F4E relied on the support of 16 interim staff (in FTE[12]).

11 Of which 164 in place and four sent (and accepted) offer letters.

12 Full Time Equivalent

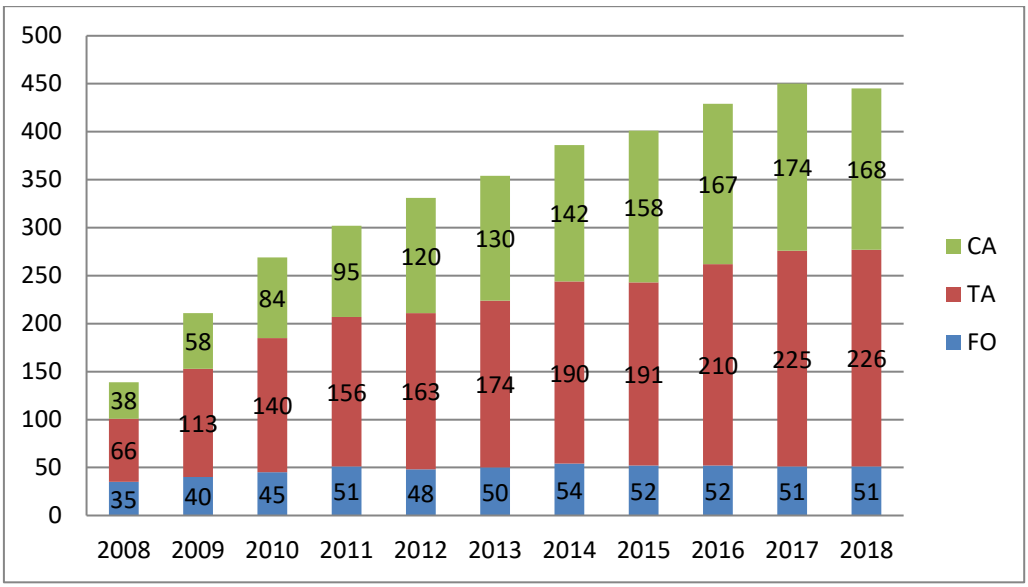


Figure 31: Staff evolution from 2008 to 2017 where FO stands for Officials, TA for Temporary Agents and CA for Contract Agents.

During 2018, 17 vacancy notices were published externally for 10 Temporary Agents and seven Contract Agents. Overall, 15 selection procedures were completed: four of which published in 2017 and the remaining 11 published in 2018.

A total of five Temporary Agents and five Contract Agents took up duties as per the following table (distributed by type of contract, category and department):

Department	FO	TA	CA
Director	-	-	-
ITER Programme	-	1 AD	
ITER Delivery	-	1 AD	1 FGIV
Broader Approach Programme & Delivery	-	-	1 FGIV
Project Management	-	2 AD	2 FGIV
Commercial		1 AST	-
Administration	-		1 FGII

Figure 32: Recruitments distributed by type of contract, category and department

Changes to the Establishment Plan During 2018:

Conversion of one FO AST into one FO AD in view of a certification procedure as foreseen in F4E Governing Board Decision of 3 December 2014 laying down the provision of Article 45a of the Staff Regulations.

Conversion of one TA AST into one TA AD. It was needed to accommodate the reclassification of an AST function into an AD level function.

HR Metrics and Reporting System

With the objective of allowing for more informed decision-making in the area of HR, a first Metrics Report was shared with the F4E Management and the Staff Committee. In addition to featuring the three HR KPIs (vacancy rate, turnover and absenteeism) already incorporated to the Multiannual Programming Document 2019-2023. The report provides a host of measurements and statistics spanning across all functional HR domains. The report will be updated on a quarterly basis and will be made available to F4E staff.

Staff Engagement Survey 2018

F4E's third Staff Engagement Survey was held. The survey gauges staff opinions on a range of domains allows formulation tailored improvement measures to address actual staff concerns. The participation rate was 75 % which is commensurate with that of other EU Agencies.

HR Satisfaction Survey and Feedback Sessions

With a view of enhancing its services, the HR unit launched its first Satisfaction Survey. 172 staff provided feedback which, by and large, was positive. The service-mindedness of HR colleagues was particularly appreciated. Learning and development and the communication to staff on HR matters were the areas most in need of enhancement. In line with the wish of the F4E colleagues to learn more about HR topics, the HR Service Desk team presented various feedback sessions on: Education Allowances; Schooling; Leaves, Sick Leave and Special Leave; Leave related to family matters; and payroll. In addition, HR organised Induction Sessions for Newcomers and Information sessions on EU Joint Sickness Insurance Scheme and Pension. The feedback gathered as part of the survey will inform the HR Unit's 2019 Work Programme.

Review of HR section on F4ENet

The HR section on F4E's intranet (F4ENet) was renewed with a modernised look and new layout featuring a more functional, intuitive structure and organisation of topics. The new page reflects staff needs for easy navigation and being able to find relevant information, and shifts the emphasis from regulatory aspects to a more user-friendly and pleasant browsing experience.

Training/Career Development:

In addition to specialised technical trainings, the 2018 Training Plan activities in soft skills and leadership targeted in particular the following key corporate objectives of F4E: improve employee engagement and enhance focus and agility. This materialised in trainings covering aspects such as communication skills but also team dynamics, influencing skills and negotiation.

Important initiatives in the area of training involved the introduction of a Project Management certification programme of F4E staff. Project Management Certification is an internationally recognised professional certification provided by an authorised body certifying the experience, knowledge and competencies in the area of Project Management.

Implementing Rules:

In addition to working with other EU Agencies and the European Commission to complete the legal framework, F4E adopted Implementing Rules on temporary occupation of management posts,

whistleblowing, middle management, advisers, learning and development and approved the application by analogy of the European Commission decisions on outside activities and missions.

Health:

F4E Medical Service in collaboration with the HR Unit launched a health campaign aimed to prevent and reduce stress. Being aware of the consequences of stress and identifying them is crucial for staff personal and professional wellbeing.

For the first time, F4E launched an inter-institutional Call for tender, opening participation to other EU agencies established in the Spanish territory. By pooling their purchasing power and resources, the participating Agencies aim to achieve economies of scale and efficiency gains. Higher volumes should translate into more favourable terms in terms of offers. The Call is scheduled to be concluded during 2019.

As every year, the specific contracts with the providers of medical services and complementary health insurance have been renewed as per the following detail:

- Provision of Medical Advisor and Nurse for Pre-recruitment examinations
- Provision of Medical Advisor and Nurse for Annual check-ups
- Medical Controller
- Complementary Health Insurance

Establishment of medical infrastructure in Cadarache. Starting from February 2018 Cadarache staff members could undergo their annual medical check-ups locally. The HR Unit signed agreements with a local ophthalmologist and a laboratory so that staff can perform the preliminary exams related to the annual check-up.

Service Level Agreement with DG HR:

F4E has signed an amendment to the Service Level Agreement with DG HR in order to use the HR management tool SYSPER for decentralised Agencies. Sysper will be the opportunity for F4E to have a modern, harmonised and interinstitutional Human Resources Management (HRM) system that supports the needs of all EU Institutions and Bodies and their unavoidable specificity. The main advantage is the possibility to manage different HR areas in one single IT application through different modules: individual entitlements, career management, time management (including flexitime and teleworking), staff allocation and reporting, job information system, etc. This will enhance better reporting and more automatisation hence reduce the risk of human errors and allow HR to focus on more strategic solutions to support F4E staff.

Flexitime Data:

The number of authorised days of leave under the flexitime scheme can be found in Annex IV. d. Flexitime scheme in 2018. The table shows the number of days recuperated per type of contract, category and grade as well as the overtime. On average, 23 % of the overtime declared by staff members was recuperated.

Staff Committee Elections:

F4E organised elections for the Staff Committee in 2018. The newly elected colleagues took up their duties in May 2018. The participation rate was high (72 %), showing the importance devoted to the role of the Staff Committee.

Reward Scheme:

F4E congratulated colleagues having reached 20 or more years of service in the European Institutions. These colleagues were invited to a medal ceremony organised by Commissioner Arias Cañete for DG ENER and F4E colleagues and a reception organised by the European Commission President Mr Juncker together with other Commission colleagues celebrating 20 years of service in the European Institutions.

Data Protection:

The HR Unit has been preparing the transition to the new data protection regulation (Regulation (EU) 2018/1725 of the European Parliament and of the Council of 23 October 2018 on the protection of natural persons with regard to the processing of personal data by the Union institutions, bodies, offices and agencies and on the free movement of such data, and repealing Regulation (EC) No 45/2001) as far as HR matters are concerned. The work will continue in 2019 as the new Regulation came into force on 11 December 2018.

Diversity:

Gender balance: The general orientations, which aim to ensure this essential principle, will be developed in line with the Commission's policy for these issues. The figures for F4E are consistent with workforce statistics in the industry sectors related to the core tasks of the Agency and show a predominance of male staff (64%).

Gender balance on 31/12/2018

Staff	EU Official		TA		CA	SNE	TOTAL
	AD	*AST*	*AD*	*AST*			
Female	12	8	43	11	88		**162**
Male	26	5	152	20	80	1	**284**
Total	**38**	**13**	**195**	**31**	**168**	**1**	**446**

Table 15: Gender balance on 31 December 2018

Geographical balance: F4E endeavours to have a balanced geographical balance. Nevertheless, this is highly dependent on the nationalities of applicants to the vacancies or calls for expression of interest. The strong representation of Spanish nationals (32%) is due to the location of F4E Headquarters in the country. They are followed by Italian nationals (20%) and French nationals (18%).

Geographical balance on 31/12/2018

Staff	EU Official		TA		CA	SNE	TOTAL
	AD	*AST*	*AD*	*AST*			
Belgian	1	1	7	4	7		**20**
British	1		13	3	5		**22**
Bulgarian			1		3		**4**
Croatian					1		**1**
Czech			2		2		**4**
Dutch			4		1		**5**
Estonian					1		**1**
Finnish			3		1		**4**
French	5	4	51	7	14		**81**
German	3		5	1	9	1	**19**
Greek	1	1	4	1	1		**8**
Hungarian	2		1		4		**7**
Irish			3	1			**4**
Italian	13	3	38	5	30		**89**
Lithuanian		1		1	2		**4**
Maltese	1						**1**
Polish			3		2		**5**
Portuguese		1	4		6		**11**
Romanian			5	1	4		**10**
Slovak	1						**1**
Spanish	9	2	49	7	74		**141**
Swedish	1		2		1		**4**
Total	**38**	**13**	**195**	**31**	**168**	**1**	**446**

Table 16: Geographical balance on 31 December 2018

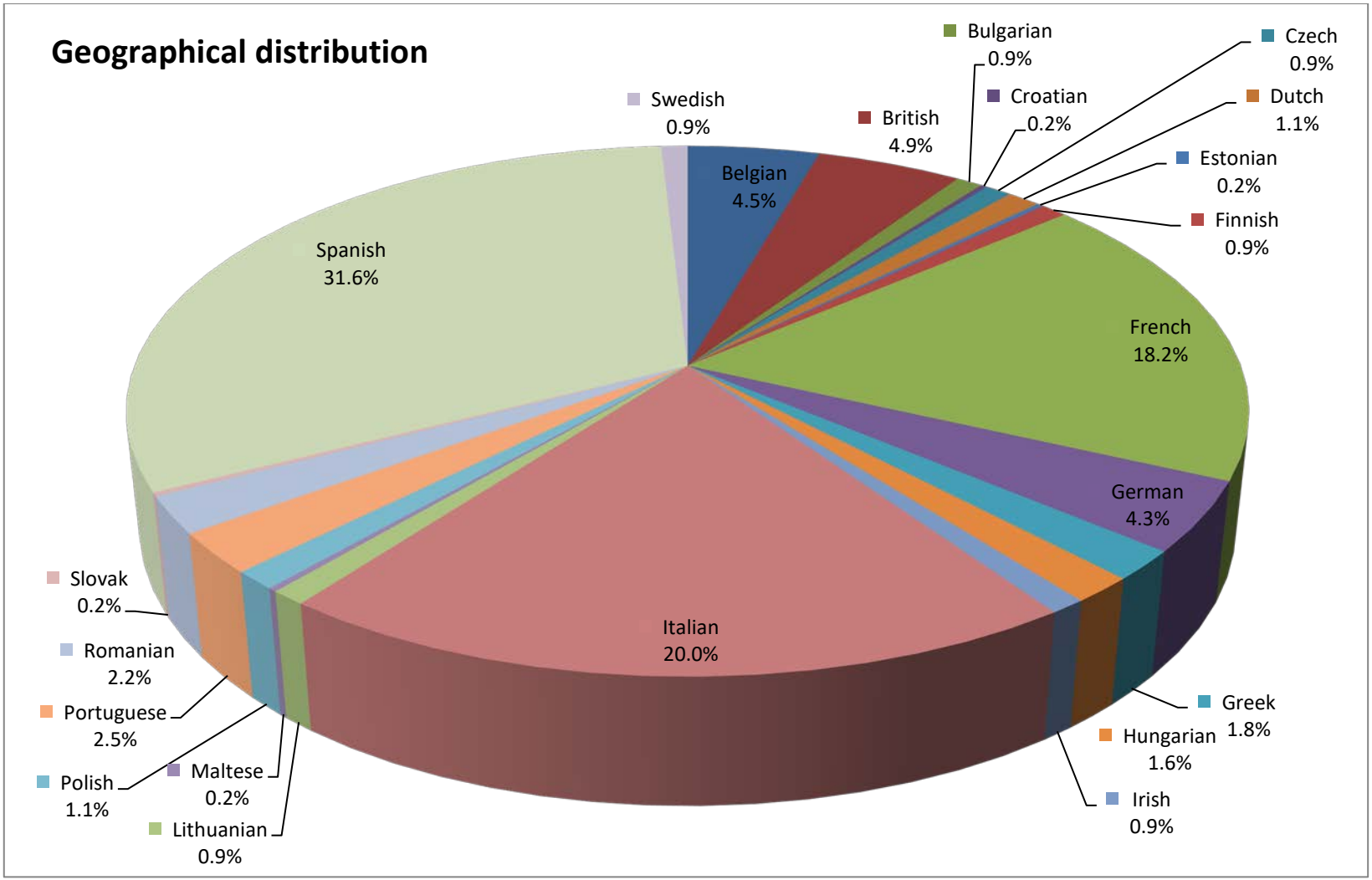


Figure 33: Geographical distribution - All F4E staff

2.5.2 The Results of the Screening/Benchmarking Exercise

This exercise is included in Annex 2 Template for Consolidated Annual Activity Report of the Communication C(2014) 9641 from the European Commission as part of the reporting on Resources Management. According to the methodology used by the European Commission, F4E staff is classified in different categories depending on the area of work at F4E. The rates per category represent the number of staff assigned to each activity out of the total number of staff (the results of the Screening/Benchmarking exercise can be found in Annex IV. c. Benchmarking Exercise).

- 14 % of the posts in F4E are assigned in the heading Administration Support and Coordination, around 75 % belong to the Operational group and 11 % are Neutral. The majority of the Operational posts are found in the category Programme Management and Implementation (PGM M/IMP) and represents 65 % of the total posts; there are no major changes in the three main headings compared to 2016;
- The increase in the heading Operational is due to the transfer of one vacant post from the screening type Administrative Support and the mobility of one staff member from category Cont to category PGM M/IMP.

2.6 Assessment by Management

The F4E Governing Board adopted F4E's 'Overall Control and Monitoring Strategy' in 2012 which aims to provide reasonable assurance to the F4E Director and external stakeholders on the state of internal control in F4E. It also sets out the framework to ensure that operational and financial transactions are implemented to the highest standards expected for such a project as ITER and to allow a close monitoring of the overall internal control system in place. This strategy is structured along three main lines: the Integrated Management System, the Control Environment and the Organisational Improvement Plan.

F4E's Integrated Management System combines the two control environments within which F4E operates, the ITER-wide Quality System which is intended to ensure the performance of ITER and the compliance with the nuclear safety requirements; and the European Commission's Internal Control Framework which is inspired by the internationally recognised COSO[13] framework.

The control objectives of this system are:

- Sound financial management of operations (effectiveness, efficiency and economy);
- Safeguarding of assets and information;
- Reliability of reporting;
- Compliance with applicable law and regulations, in particular:
    - Quality aspects and nuclear and safety requirements;

13 Committee of Sponsoring Organizations of the Treadway Commission

- Legality and regularity of budget implementation;
- Prevention, detection, correction and follow-up of fraud and irregularities.

F4E's control environment is composed of independent assurance functions (Internal Audit Capability, Internal Audit Service, European Court of Auditors and Annual Assessments) and management assurance functions (Authorising Officers by Delegation and Sub-Delegation, Assurance strategy on grants and procurement contracts, Corporate Risk, Corporate Supervision Functions, Quality Management System and Fraud Prevention and Data Protection).

The main results of the control procedures carried out by the F4E management assurance functions are described below and in section 3.1 Risk and Opportunity Management. The results of the independent assurance functions are described in sections 2.8 Assessment of Audit Results During the Reporting Year', 2.9 Follow-up of Recommendations and Action Plan for Internal Audits', and Part II. (b) External Evaluations.

2.6.1 Assurance from the Authorising Officers by Delegation and Sub-Delegation

In addition to the above assurance functions, each staff member who received a delegation or sub-delegation for the implementation of F4E's 2018 budget had to provide a "Declaration of Assurance" for the budgetary area for which they were responsible.

In 2018 the decentralisation of budget powers followed the organisational structure, with a clear segregation between administrative and operational project management, empowering staff members within their areas of responsibility.

In total, 46 Declarations of Assurance were received for 2018; none of these contained a reservation nor raised any issue of significance that may have an impact on the F4E Director's Declaration of Assurance. Notwithstanding this, an observation has been included in the F4E Director's Declaration of Assurance to draw the attention of the reader on the most significant risks F4E is addressing at a corporate level. These risks may lead to cost increases and schedule delays, which are inherent to the magnitude and complexity of the ITER in-kind delivery project. It should be underlined that these risks do not call into question the legality and regularity of the underlying transactions of the 2018 annual accounts.

These declarations together with the reports from the different assurance functions form the basis for the Part V. Declaration of Assurance.

2.6.2 Assurance Strategy on Grants and Procurement Contracts

F4E's 'Assurance Strategy on Grants and Procurement Contracts' was endorsed in 2014 by the Audit Committee. In the case of F4E grants, which are similar to the Horizon 2020 grants of the European Commission, the costs are reimbursed on the basis of declarations of costs incurred by the beneficiaries and therefore have to be subject to ex-post audits in order to ascertain their legality and regularity. These ex-post audits are performed either with in-house resources (financial verifications) or outsourced via a framework contract concluded between the European Commission and three external audit firms.

F4E grants account for a minimum portion of the F4E operational budget; in 2018, F4E's commitments on grants represented only 0.87% of the total of € 639m of operational commitment appropriations for the year. In order to efficiently use the resources available, the selection of beneficiaries to be audited focuses on the top beneficiaries who have not been previously audited by the Research Directorate-General and Executive Agencies of the European Commission or for which such audits resulted in significant findings.

In 2018, the outsourced ex-post audit at a Hungarian beneficiary was finalised and F4E started an additional verification in order to complement the findings of the external auditor. F4E expects to implement the financial adjustments during the course of 2019.

The financial verification at a German beneficiary that had been launched in 2016 was finalised with the conclusion that no financial adjustment would be needed. As for the joint audit with the Research Executive Agency (REA) of a Greek beneficiary that was launched end of 2016, it was stopped due to the poor performance of the external auditor. As the beneficiary had claimed actual indirect costs instead of the flat rate, F4E initiated the process of recovery of the corresponding amounts (€ 51k).

In 2017, an additional audit was performed at an Italian beneficiary to assess if some costs were eligible before being reimbursed. The outcome of the audit resulted to an additional payment of € 54k paid in 2018. Furthermore, F4E carried out a new audit at a Swiss beneficiary and based on the fieldwork assessment it resulted in no financial impact.

For procurement contracts, based on agreed-upon prices, the same principles applied for ex-post controls on grants cannot be applied. F4E procurement contracts are, instead, subject to controls on a much broader basis than the ex-post controls and verifications applied to grants. These controls are performed via assurance engagements carried out by the F4E's Internal Audit Capability and cover the financial, compliance, quality and performance aspects of contracts. For further details on the activities of the F4E's Internal Audit Capability, please refer to section 2.8.2 Internal Audit Capability (IAC).

2.6.3 Corporate Supervision Functions

The corporate functions at F4E supervise the legality and regularity of transactions as well as the sound financial management.

The **Procurement and Contracts Committee (PCC)** is composed of the Chair and five members and its mandate is to:

- Recommend the award of contracts with a value exceeding € 20m and grants exceeding a value of € 4m as well as comment on important contract amendments;
- Comment on draft ITER Procurement Arrangements between Fusion for Energy and the ITER International Organization;
- Comment upon the overall strategies proposed by F4E for delivering each ITER procurement package;
- Recommend the individual procurement strategies for important individual calls for tender or proposals in advance of launching contracts or grants;
- Comment upon the model procurement contracts, grant agreements and framework partnership agreements.

The **Internal Review Panel (IRP)** is an internal function of F4E, which complements the PCC by reviewing the correctness of the procedural aspects followed for contracts and framework contracts. Its scope is to review procurement procedures with a value equal to or above € 1m and grants or framework partnership agreements with a maximum F4E contribution equal to or above € 400k.

In July 2018, the role of IRP evolved in the context of a global revision of internal processes. The IRP assumed a consulting role in support of authorising officer decisions and can now meet upon authorising officer request and already in the starting phases of a procurement procedure. This new consulting role was complemented by the mandatory involvement of the legal officer in all the procurement procedures at F4E.

In 2018, the Internal Review Panel met 11 times and reviewed 14 contracts. The IRP found that compliance of the submitted procurements with the F4E procedural requirements has further improved during the year as no file evidenced weaknesses justifying a rejection.

In addition, through its general recommendations, the IRP identified solutions for recurrent issues. These recommendations have been followed up and have been implemented or are in the process of being implemented.

The **Financial Supervision**, performed by the Finance Unit of F4E, examines the financial transactions from a compliance and efficiency perspective and responds to the need for further control mechanisms after the decentralisation of the financial circuits. In 2018, F4E launched a financial campaign in order to assess how the data are recorded in ABAC and verify if they comply with the provisions of the contract or grant, in particular in relation to:

- payment modalities,
- suspension of payments and,
- interest rate to be applied in case of a delayed payment.

The result showed that some transactions were registered with incorrect data, however these errors did not affect the compliance of the transaction with the contract, neither were they found to be against the provisions of the Financial Regulation/Implementing Rules (FR/IR).

In July 2018 because of the Improvement Project on Roles and Responsibilities, an important update of the Financial Circuits was made to reflect the changes within the Commercial Department, in particular with the introduction of the Commercial Manager role.

A preliminary assessment of the improvement actions and its benefits has been made and reported to the F4E Improvement Steering Committee in January 2018 to measure the performance of the financial processes. The analysis demonstrated that the trends in terms of efficiency gain for the financial processes were meeting the expected results. In addition, an analysis of the Commercial Department processes was also presented with the aim to provide a factual overview of the tasks being performed by the finance roles and to quantify the time/effort for each of the tasks performed. This analysis was used to define the role of the Commercial Manager and to evolve the organisational structure of the Commercial Department.

2.6.4 Quality Management System

In 2018, F4E continued the implementation and development of the Quality Management System through four main activity areas:

Business Process Management

According to the ISO-9000 series and its quality management principles – a desired result is achieved more efficiently when activities and related resources are managed and documented as a process. The process approach is also a requirement of the IAEA Safety Requirements GSR Part 2, which together with ISO-9001 are the standards followed by F4E to comply with the ITER project quality, safety and management requirements. The F4E quality system is a stakeholder-oriented system, taking into account equally:

- The requirement definitions;
- The stakeholder feedback;
- F4E compliance with the requirements.

Following this approach F4E has continued to strengthen its 'process strategy by assessing the maturity of the various elements of its 'process map' showing the links between all activities to carry out across the organisation. F4E also adopted a Business Process Management policy to define the organisational framework and principles to define, measure, analyse, improve and control business processes.

In 2018 F4E continued the contract management improvement exercise with the further development of the online database and electronic tool for the management of the contract modifications, including the development of the BIPS modules with contingency and reserve fund management.

At the same time all the processes were updated to reflect the 2018 ongoing improvement projects (mainly the Procurement Lead Time, Roles and Responsibilities Contract Management and Financial Circuit, Integrated Change Control and Selection projects).

With the new Business Process Management frame and its implementation in 2018, F4E reinforced the common frame of documents types and standards, simplified the approval flow yet secured consistency, defined the process map and process groups to classify all processes available, developed improvement plans per process groups, and moved to navigation by process in the F4E Manual.

The statistics of the working procedures development during 2018 (either new developments or updates of existing ones) were:

Process Group (PG)	Standard	Policy	Process	Procedure	Instruction	Total by PG
Corporate planning financial controlling and reporting	2	5	3	1	5	16
Organisation & system management		2	1	2	2	7
Document management		3	1		6	10
Human resources			6			6
Infrastructure & logistics		1				1
Financial management		1	1			2
Procurement and contract/grant implementation	1	2	14	1	2	20
Total releases by Type	**3**	**14**	**26**	**4**	**15**	**62**

Table 17: Statistics on the process development status

As part of the Integrated Management System, the F4E Manual aims to closely mirror the evolution of the organisation and encourage a harmonised approach in the development and application of working procedures to achieve organisational objectives on all levels (corporate, departmental and individual staff objectives).

Quality Assurance in Support of the Operational Projects

Quality Assurance is defined as part of quality management focused on providing assurance that quality requirements will be fulfilled.

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

- Support and review of the Procurement Arrangements and ITER Task Agreements to ensure conformance with the F4E Quality Assurance Programme, the ITER Organization-Domestic Agency coordination meetings in quality and safety and issue of the implementation templates;
- Full support to the technical departments on quality issues of contracts and grants, verification of the Call for tender documentation (including full review of the management specifications) for compliance with the F4E Quality Assurance Programme and issue of the follow-up documentation templates;
- Training on Quality Assurance and nuclear safety to suppliers providing 'protection important class' items and/or services;
- Verification of the suppliers' quality plans and all the contract implementation quality documentation;
- Full support regarding Quality Assurance to the kick-off and progress meetings, as well as the control point quality-related visits;
- Perform monitoring, audits and assessments of the Quality Management System implementation within the suppliers.

Another major support Quality Assurance activity is the coordination, registry and reporting of **Nonconformities and Deviations**:

- A Nonconformity is a non-fulfilment of a requirement. A Deviation is a planned alternative to a specified requirement. These requirements come from procedures, the item and service specifications or from the stakeholder.
- F4E has defined a process for handling all aspects of the detected nonconformities in line with ITER Organization requirements. All F4E personnel are responsible for the identification and reporting of any detected Nonconformity.

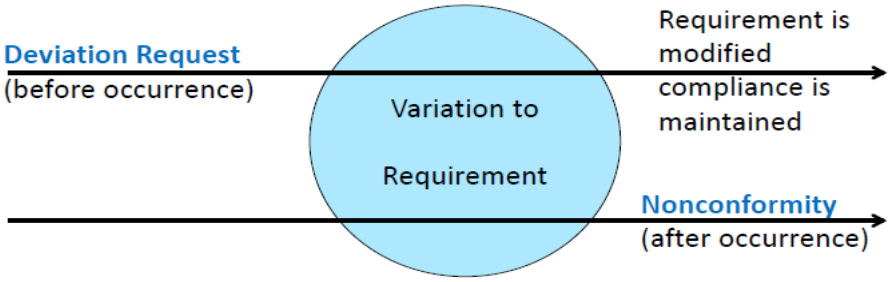


Figure 34: Schematic representation of the Deviation and Nonconformity

- Any deviation (or modification) to a specified requirement identified by F4E or the supplier shall be handled by the dedicated deviation procedure and the F4E configuration management process. A detailed process exists at F4E for the management of deviations.
- Nonconformities and deviations are addressed at F4E in a graded approach, where the most significant (higher impact on cost and/or performance) require a stricter control and review.
- In 2018 the main types of nonconformities (includes from Supplier Audits) are represented in the table below:

Nonconformities (F4E classification)	Cases	(~) %
Major (impact on customer critical requirements)	358	59
Minor (impact on customer non-critical requirements)	127	21
Relevant (impact on F4E contract, but not on customer requirements)	95	16
Technical Exception (no impact on F4E contract or customer requirements)	0	0
Pending classification	24	4
Total	604	--

Table 18: Statistics on nonconformities by type

- Corrective actions are triggered by the occurrence of Nonconformity to eliminate the cause and prevent repetition.
- In 2018 the main types of deviations are represented in the tables below:

Deviations (F4E classification)	Cases	(~) %
Level A (no impact on F4E contract or customer requirements)	84	11
Level B (impact on F4E contract, but not on customer requirements)	303	40
Level C (impact on customer requirements)	248	32
Cancelled or still to be defined (in the process of assessment)	133	17
Total	768	-

Table 19: Statistics on deviations by impact

Deviations (by type)	Cases	(~) %
F4E DR (Deviation Request by F4E, internally or to customer)	94	12
Supplier DR (Deviation Request by the supplier to F4E)	232	30
ITER IO DR (Deviation Request by ITER IO towards F4E)	35	5
Deviation Notice/Order (deviation by F4E towards supplier)	391	51
Dropped/Not Finished	16	2
Total	768	-

Table 20: Statistics on deviations by type

Quality Management System and Supplier Audits

A Quality Management System Audit aims at providing F4E and its stakeholders reasonable assurance that the system is adequately implemented according to the standards. F4E is developing and implementing an annual audit plan to assess that the quality requirements are properly fulfilled by F4E Project Teams and F4E Suppliers. A quality audit process frames the methodology to be followed for each key step of those audits (planning, preparation, implementation, follow-up of actions and recording).

The objective of Supplier Audits is to ensure that F4E Suppliers comply with the Quality Plan and it is effectively implemented. The internal Quality Management System Audit also aims at ensuring that operational teams comply with the F4E Quality System requirements and ensure it is effectively implemented.

Each audit result is presented in an audit report, which includes the identification of any strong areas describing the strengths of the Supplier Quality Plan, improvement areas and nonconformities. When improvements or nonconformities are identified, the report is followed by an action plan from the auditee to address the findings.

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

At the end of 2017 the 'Annual Quality Management System Programme' and the "Annual Supplier Audit Programme" for 2018 were developed and approved for implementation.

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

In 2018, out of the 27 Quality Management System and Supplier audits planned:

Quality Management System Audits	Cases	(~) %
Supplier Audit – Operational Contracts	21	78
Supplier Audit – Cancelled/Postponed	2	7
Internal on quality management system implementation	3	11
Internal on QMS – Cancelled/Postponed	1	4
Total	27	-

Table 21: Statistics on quality management system and supplier audits by type

The global results of the Quality Management System and Supplier audits are detailed in the table below:

Audit Result	Internal QMS Audit		Supplier Audit	
	Cases	(~) %	Cases	(~) %
with an Acceptable Result	3	100	16	76
with an non-Acceptable Result	0	0	5	24

Table 22: Statistics on the results of quality management system and supplier audits

These audits resulted in 214 findings, classified as follows:

Audit Finding	Internal QMS Audit		Supplier Audit	
	Cases	*(~)* %	Cases	*(~)* %
Strong Areas	4	13	23	13
Improvement Areas	26	84	118	64
Nonconformities	1	3	42	23
Total	31	-	183	-

Table 23: Statistics on the findings of quality management system and supplier audits

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

Continual Improvement of the Quality Management System in 2018

The Management Standard 19 'Continual Improvement' requires F4E to continually improve the effectiveness of the Integrated Management System and where necessary takes corrective and preventive measures to address weaknesses. In line with this requirement, F4E performed the several improvements in 2018, see further details in section 3.2.1 Organisational Improvement.

2.6.5 Fraud Prevention and Data Protection

The independent function of Anti-Fraud & Ethics as well as the Data Protection Officer of F4E, established and respectively reinforced in 2015, with a direct reporting line to the Director, was in 2018 one of the important components of the management assurance functions of F4E's control environment. This function provided oversight and expertise to prevent fraud occurring and to protect the personal data of staff and other stakeholders when F4E is processing their personal data to fulfil its objectives.

Fraud Prevention

The **Anti-Fraud (OLAF) & Ethics Officer**, continued coordinating the implementation of F4E's Anti-Fraud Strategy in close cooperation with all respective units. For this purpose and in view of having continuous follow-up in the most sensitive areas for F4E, contact persons have been identified in HR, Finance and Contract/Procurement, who are mentioned on the F4E Intranet (F4ENet), in a dedicated section "Ethics Point". This part on the intranet is easily accessible and refers to the Staff Ethics and Conduct of the European Commission as well as to the Ombudsman Public Service Principles of the EU. All awareness raising sessions were also published there and the page is

constantly updated. A working group has started at the end of 2018 continuing work on the Anti-Fraud Strategy.

Two general awareness sessions for all staff on “Ethics & Compliance” took place (in April and May 2018), including the F4E Overall Control Environment, i.e. ethical principles, internal control, risk, quality and internal audit, therefore promoting and transmitting to staff a comprehensive vision and approach.

The F4E Whistleblowing Policy, including its procedure and Privacy Notice was revised aligning it to the new Commission Implementing Rules and adopted in August 2018. Furthermore, an assessment procedure for the General Declarations of Interests (GDoI) was established, together with respective guidelines, the assessment form, the procedure and the Privacy Notice.

F4E continued to manage the Conflict of Interest Register, that was set up in 2017, and that shall contain all (General and Specific) Declarations and assessments. The yearly reminder to update GDoIs was sent in January 2018. With regard to the staff selections, the Ethics Officer continued to regularly check the declarations and assessments made, and followed up respectively if necessary.

Data Protection

In 2018, the **Data Protection Officer (DPO)** prepared the ground for F4E to be compliant with the Data Protection (DP) Reform. In January an action plan was established in view of the coming into force of the DP Reform for the European Institutions and thus for F4E (in December 2018). Based on an analysis table comparing the old and new provisions the action plan defined the necessary steps to implement the new framework. The instruments which enable F4E to be compliant with this reform included e.g. the establishment of new templates for records, privacy notices and DP impact assessments (risk assessments), elaboration of a new DP contract clause, decentralising the documentation, maintaining the register with the DPO, etc. The respective section on the F4E intranet was revised to allow DP coordinators and staff to understand and adapt the F4E processing of personal data to the new requirements. As it is important to get respective management support for the shift of culture (accountability with the process owners), the DPO presented the DP Reform, its requirements and implications for F4E to the Senior Managers and raised awareness with all managers as well as with DP coordinators and individual departments. Furthermore, during the whole preparation, the F4E DPO maintained close contacts and worked with DPOs of other European Institutions as well as with the European Data Protection Supervisor (EDPS).

The DPO also handled procedures, together with the responsible unit, e.g. in a case of a complaint addressed to the EDPS on data breach. With the coming into force of the General Data Protection Regulation 2016/679 (GDPR) in May 2018, some (access) requests were received.

2.7 Budget Implementation Tasks Entrusted to Other Services and Entities

There are no F4E activities delegated to other European Institutions or Bodies.

2.8 Assessment of Audit Results During the Reporting Year

2.8.1 Internal Audit Service (IAS)

The Internal Audit Service (IAS) of the European Commission concluded two follow-up reports in 2018 and beginning 2019, on the 'Document Management and Information Security audit' and on the 'Implementation of Procurement Arrangements limited review'.

Document Management and Information Security audit

The IAS carried out a follow-up which was finalised in February 2019 and concluded that the five recommendations issued by the IAS had been adequately and effectively implemented.

Implementation of Procurement Arrangements limited review

As for the follow-up on the 'Implementation of Procurement Arrangements limited review' which was finalised in February 2019, the IAS concluded that out of the five recommendations accepted by F4E Management (out of the six issued by the IAS), three had been effectively implemented but the remaining ones:

1. Establish a commercial Project Change Request (PCR) process to monitor the cost of changes, aligned with the requirements of the ITER Reserve Fund mechanism
2. Strengthen and enforce procedures on the cost impact assessment of changes imposed by ITER Organisation (IO)

had not been adequately and effectively implemented. However, the IAS assessed that, in view of the actions already taken, their priority can be downgraded from 'very important' to 'important'. F4E has reviewed the action plan in order to address IAS concerns and will implement both recommendations by the end of 2019.

Strategic Internal Audit Plan (SIAP) 2019-2021

In addition, in September 2018 the IAS concluded its Strategic Internal Audit Plan (SIAP) for the period 2019-2021, based on a risk assessment performed during 2018 and where the possible audit topics for the years to come were identified. In November 2018, they launched the audit on 'Project management of ITER Deliverables' for which the audit fieldwork will take place in April 2019. The SIAP also identified certain immature processes exposed to high inherent risk, for which F4E provided an action plan to mitigate those risks which are being closely followed up by F4E Management.

Annual report of the IAS

Article 82(6) of the F4E Financial Regulation[14] provides that, beyond reporting on his findings and recommendations in audit reports, "the internal auditor shall also report to the Governing Board, or where the Constituent instrument allows it, a body delegated by the Governing Board and to the Director in any of the following cases:

- Critical risks and recommendations have not been addressed;
- There are significant[15] delays in the implementation of the recommendations made in previous years.

As of February 2019, when the follow-up on the 'Implementation of Procurement Arrangements limited review' was finalised, there were no open critical recommendations or significantly delayed very important recommendations. Therefore, the IAS did not issue the report foreseen in art 82(6).

The status of implementation of the IAS audit actions can be found in section 2.9 Follow-up of Recommendations and Action Plan for Internal Audits of this report.

2.8.2 Internal Audit Capability (IAC)

In 2018, F4E's Internal Audit Capability (IAC) performed four assurance engagements: Audit of Technical Support Services; 2018 Validation of User Access Rights in the Accounting System (ABAC); Audit of Implementation of the Broader Approach (BA) Agreement and Audit Follow Up of Contracts in the Area of ITER Cryoplant and Fuel Cycle.

These engagements resulted in 26 new recommendations, out of which 23 (89%) were accepted or accepted with comments by the management. In addition, seven recommendations have been followed up and all were considered as implemented and therefore closed.

IAC also provided consulting services in two areas, which led to suggestions for improvement in the areas of budget management and fraud prevention, in particular as reflected in the Consulting Report on Forecasting and Control of the 2018 Budget for the Tuition Fees under the F4E Schooling Scheme and IAC's inputs related to continuous support in the area of Ethics and Anti-Fraud, including organisation of Compliance Awareness trainings.

The following are summaries of the Internal Audit Capability's 2018 audit and assurance engagements:

Audit of Technical Support Services

Overall IAC concluded that the control framework in the area of Technical Support Services (TSS) is Analysed and Managed in all material respects, with the exception of weaknesses in the areas of public tendering, management of requests for TSS services, evaluation of specific task offers, reporting of schedule data and supervision of the TSS as organisational unit.

[14] https://f4e.europa.eu/downloads/procurements/F4E_Financial_Regulation.pdf

[15] *Recommendations are considered significantly delayed if they are still open more than six months after the original expected date of implementation.*

As a result of the audit, IAC proposed to implement eight recommendations.

2018 Validation of User Access Rights in ABAC

The overall conclusion was that the ABAC access rights were generally in line with the roles and delegations entrusted to the staff of F4E. As a result of the review IAC recommended to correct ten findings.

Audit of Implementation of the Broader Approach Agreement

Overall IAC concluded that the overall control framework for the implementation of the Broader Approach (BA) Agreement by F4E as the European Implementing Agency is Well Defined and Governed in all material respects, with the exception of weaknesses in the areas of schedule slippage of LIPAc accelerator, information on financial values of BA contributions, BA quality management documentation, asset management, documentation of the work of the BA governance, formalisation of the BA secondment arrangements, ownership of domains and communication on BA activities, and stipulation of final payment terms in the contracts.

As a result of the audit, IAC proposed to implement eight recommendations.

Audit Follow Up of Contracts in the Area of ITER Cryoplant and Fuel Cycle

The results of the follow up review showed that out of the seven recommendations proposed in 2016 by the Internal Audit Capability all were implemented and could be closed. Four recommendations were closed as the residual risks were assessed as low. Three recommendations were closed although some residual risks remained.

Consulting Report on Forecasting and Control of the 2018 Budget for the Tuition Fees under the F4E Schooling Scheme

Two significant issues were identified by IAC in the course of the consulting engagement. The first one was related to the roles and responsibilities for budget preparation, hearings, forecasting and controlling, which are not adequately and completely defined and described in the quality system. The second one was related to compliance risks with respect to a specific regularisation payment for significant part of the 2018 mission expenditure, which the management agreed addressing in the future and covered in a specific note concerning project cost accounting methodology.

In this context IAC noted that both administrative and in particular operational expenditure shall be justified and appropriate for the mission of F4E, recalled that the principle of sound financial management applies equally to administrative and operational expenditure.

Opinion on F4E's Overall System of Internal Control

The Internal Audit Capability provided the following conclusions and opinion on F4E's overall system of internal control for the year 2018:

Regarding the effectiveness of internal controls, IAC concluded that overall there is acceptable segregation of tasks, an appropriate risk management and control strategy, including controls performed at recipient and contractor level, procedures for monitoring of performance and for follow-up of internal control weaknesses and exceptions, and assessments of aspects of the internal control system.

Regarding the efficiency of internal controls, IAC concludes that overall the risk management and control strategies are coordinated by the actors in the control chain, the control results are made accessible to the relevant actors, there is reliance on the work of independent auditors, monitoring of audit recommendations is performed by the management, and improvement mechanisms to reduce multiple controls are in place.

IAC formulated the following opinion on F4E's overall system of internal control:

Based on our work as described in the IAC's Annual Report, and while drawing attention to the areas with important risk exposures and control issues audited or reviewed by IAC in 2018 as listed below, nothing has come to our attention, which would cause us to believe that the Overall System of Internal Control of Fusion for Energy is not Analysed and Managed in all material respects.

In the course of our main assurance engagements performed in 2018 we identified areas with important risk exposures and control issues with impact on the achievement of the following internal control objectives:

- Efficiency and effectiveness of operations – in particular regarding formulation and alignment of corporate and staff objectives
- Safeguarding of assets and information – in particular regarding the asset management of scientific equipment
- Legality and regularity of the transactions – in particular regarding the use operational budget for administrative type of expenditure
- Reliability of reporting – in particular regarding monitoring of the contractually agreed milestones

2.8.3 European Court of Auditors (ECA)

In November 2018, the European Court of Auditors (ECA) adopted the final report[16] on the 2017 annual accounts of F4E, expressing a reasonable assurance for the implementation of the 2017 budget:

- The Joint Undertaking's annual accounts present fairly, in all material respects, its financial position as at 31 December 2017 and the results of its operations and its cash flows for the year then ended;
- The transactions underlying the annual accounts of the Joint Undertaking for the year ended 31 December 2017 are, in all material respects, legal and regular.

Emphasis of matter

As in the five previous Annual Reports from the ECA, this report includes, in the Opinion section, a sub-section 'Emphasis of Matter' raising awareness on the problems faced by the ITER project in relation to the cost and schedule of the overall project. The ECA refers to the updated integrated schedule approved by the ITER Council in November 2016 and which follows a staged approach, with the 'First Plasma' date set to December 2025 and the estimated completion date for the whole

[16] *https://www.eca.europa.eu/lists/ecadocuments/f4e_2017/f4e_2017_en.pdf*

construction phase set to December 2035, a delay of 15 years compared to the original baseline. This schedule is considered to be the earliest possible technically-achievable date.

In relation to the cost, the ECA highlights that the expected funding requirement for the construction phase after 2020 is € 5.4bn (which means an 82 % increase over the approved € 6.6bn budget). The amount of € 6.6bn (in 2008 values) adopted by the Council of the EU in 2010 now serves as a ceiling for the Joint Undertaking's spending up to 2020. They also refer to the contribution to the operational phase of the project beyond 2035 not having been yet estimated.

While positive steps have been taken to improve the management and control of the ITER project construction phase, there remains a risk of further cost increases and delays in project implementation compared to the new proposed baseline, in particular as the updated ITER baseline does not include any contingency.

Finally, the ECA refers to the European Commission's communication on the EU contribution to a reformed ITER Project, seeking the support from the European Parliament and a mandate from the Council of the EU for the Commission to approve the new baseline on behalf of Euratom. The ECA refers to the significant effect that the Brexit may have on the future activities of the F4E Joint Undertaking and the ITER project.

Observations of current and previous years

In addition, the 2017 ECA annual report also included 14 observations that do not affect the overall assurance: six observations corresponding to the findings of the year 2017 and eight observations following on previous years' findings. The following table provides an overview of the status of these observations at the end of 2018:

Area	In Progress	Implemented	No Action	Total
Implementation of the 2017 budget			1	**1**
Payment appropriations		1		**1**
Monitoring of Declarations of Interest		1		**1**
Shortcomings in recruitment	1			**1**
European Court of Justice annulling employment decisions	1			**1**
Information/dissemination within the organisation	1			**1**
TOTAL from 2017	**3**	**2**	**1**	**6**
Follow up of previous year's comments				
Presentation of the Accounts	1			**1**
Key controls of the Joint Undertaking's Supervisory and Control Systems		2		**2**
Operational procurement contracts and grants – Negotiated procedures		1		**1**
Legal Framework		1		**1**
Intellectual property rights and industrial policy		2		**2**
Antifraud Strategy		1		**1**
Total from Follow up	**1**	**7**	**-**	**8**
GRAND TOTAL	**4**	**9**	**1**	**14**

Table 24: Observations and actions taken by F4E

The status of the four remaining actions in progress is the following:

- **Shortcomings in recruitment** of key management staff: Different actions have or are being introduced to improve the selection procedures at F4E. The following actions are being introduced in F4E as agreed with the Audit Committee in its meeting of 11-12 December 2018:
    a) Appointing Authority will not be the chair of external selection committees;
    b) Monitoring of declarations of conflict of interest of selection committees' members will be enhanced;
    c) Selection panel decisions will be adequately documented;
    d) In future vacancy notices, the indicative number of candidates to be shortlisted will be included.
- **European Court of Justice annulling employment decisions:** The Court delivered its judgement on 25 January 2018, annulling the results of the selection procedure including the appointment of the persons hired from the reserve list. F4E gave effect to this decision (i.e. annulling the decision not to admit the plaintiff on the reserve list, annulling the reserve list, informing the persons concerned, terminating contracts). On 3 April 2018, F4E submitted its appeal to the Court, contesting the decisions to annul the reserve lists and the decisions to hire the candidates.
- The Advocate General delivered his opinion on 29 January 2019. In this, he agrees with F4E arguments and suggests to the Court to annul the General Court's judgement in its part which annulled the hiring decisions, but not the annulment of the reserve lists. As a next step, the Court will deliver its judgment on the appeal.
- **Shortcoming on information/dissemination** of estimated cost of decommissioning within the organisation: In agreement with the ECA, F4E has recognised the provision for the decommissioning costs in its 2017 final accounts. In addition, F4E has tackled this shortcoming through the following actions:
    a) First, the F4E internal process "Annual accounts – opening/closure of financial year" is currently being updated, in order to clarify the information needed for the accounts in relation to provisions and contingent liabilities.
    b) Second, Senior Management is already transmitting to the Accountant any relevant information, in particular the Management Advisory Committee and ITER Council decisions.
- **Presentation of the accounts** (observation from 2015)**:** F4E is currently using the ITER credit as its Earned Value Management (EVM) system and it is one of the methods, together with milestones monitoring and trend analysis, to monitor the progress in its activities. This status information is tracked via the F4E Integrated Reporting System, and is reviewed regularly by F4E senior Management. At the end of 2017, F4E's Governing Board appointed an Ad-Hoc Group (AHG) with the task of reviewing the F4E reporting, and proposing any changes and/or refinements if necessary. F4E has made some proposals to the AHG based on the above ITER credit system which are under discussion with the AHG. The AHG chair will make a proposal to an extraordinary Governing Board that will take place in April 2019.

In relation to the observation **Operational procurement and grants** (observation from 2015) it has to be noted that the ECA report considers the use of **Negotiated procedures** is still common at F4E despite efforts to increase the competitiveness of its operational procurement procedures. ECA reports this observation as ongoing, whereas F4E considers that it has taken all the actions under its remit to address this issue and reminds that the use of the negotiated procedures is fully compliant with the legal framework applicable to the Joint Undertaking.

In spite of renewed communication and dissemination efforts, notably in the context of integrating the new Financial Regulation, the figures for negotiated procedures remained during 2018 similar

to previous years (52 % of total in 2018, versus 47 % in 2017, 49 % in 2016, 45 % in 2015 and 58 % in 2014).

Nevertheless, it has to be noted that the majority of these procedures were for low-value negotiated procedures performed below the Directive's publication threshold and fully in line with the F4E Financial Regulations. These low value negotiated procedures represent a long-term average of around 40 % of F4E's yearly number of contracts but only correspond to less than 1% of the annual commitment budget.

Using negotiated procedures in these cases (within the limits imposed by F4E's Financial Regulations) responds to a concern of sound financial management, as this allows F4E to reduce time-to-contract, reacting more swiftly to the project needs and more effectively focusing use of internal resources on high value procurements. Therefore, F4E considers that no action is needed to further reduce low value negotiated procedures, which remain in compliance with the Financial Regulations principles and provisions.

The remaining negotiated procedures, typically higher value contracts (about 5 % of the total number of procedures as long term average), are an expression of the complex and innovative context in which F4E operates. The characteristics of the fusion technology market are such that in many cases very limited capacity is present in Member States or worldwide. This often results in low competition levels, duopolies/monopolies or even lack of participation to Calls for tender.

Since 2012, F4E increased its dissemination efforts but participation to its operational calls remained in average lower than desirable. During 2018, an average of 3.3 tenders were submitted in response to F4E's competitive Calls for tender (therefore excluding the low value negotiated procedures mentioned above). Through discussion with other large science infrastructure buyers in Europe, F4E observed that this situation is common among organisations with similar scope. The nature of the activities related to the scope of large science and technology projects is such that limited competition is a matter on which a single contracting authority can have only a modest impact. This conclusion is shared by other contracting authorities managing similar projects in Europe.

As a consequence, during 2016 F4E initiated a forum comprising most similar, first of a kind high-tech frontier projects in Europe. Through this forum different organisations with similar project challenges began working together to address them in a more coordinated and effective way. Among the key ideas generated through this forum is to foster a single market for large scientific projects, which is more stable and larger and therefore more capable of attracting companies' interest and industrial investment.

The forum's first event targeting industry took place in Denmark at the end of February 2018, with participation of 1 037 delegates representing 530 companies and public organisations from 29 countries. The following event will be hosted by Spain in October 2020.

2.9 Follow-up of Recommendations and Action Plan for Internal Audits

The status of the implementation of the internal audit action plans as of February 2018 is as follows:

Overview per Audit:

			ACTION PLAN					
Audit Name	Audit Source	recommendations	Actions	In Progress	Implemented	Cancelled	Obsolete	Implemented %
Selection and Recruitment follow up concluded on 9 additional recommendations	IAF	27	47	5	38	3	1	88.37%
Neutral Beam and Electron Cyclotron PSS Contracts Audit	IAF	15	22	0	20	2	0	100.00%
Implementation of Procurement Arrangements	IAS	6	15	5	10	0	0	66.67%
In-Vessel Contracts Audit	IAF	10	43	1	42	0	0	97.67%
Technical Support Services Audit	IAF	8	16	13	3	0	0	18.75%
Broader Approach Agreement Audit	IAF	8	9	6	3	0	0	33.33%
		74	152	**30**	**116**	**5**	**1**	**79.45%**
				19.74%	**76.32%**	**3.29%**	**0.66%**	

Table 25: Implemented % is equal to the number of actions implemented per total number of actions that can be executed (Cancelled and Obsolete actions are not taken into account)

Progress was made implementing audit actions during 2018, with the rate of implementation slightly decreasing (79.45 % in 2018 compared to 81.43 % in 2017) as F4E dealt with a smaller portfolio than last year (152 actions in 2018 compared to 219 actions in 2017) due to the closure of three audits after the succesfull follow-ups performed by the auditor.

During 2018, F4E issued two new action plans in response to the two new audit reports (IAC audits on Technical Support Services and on Broader Approach Agreement), with 25 new actions. The IAC audits on Procurement in the area of ITER Buildings (40 actions), Contracts monitoring in the area of buildings (24 actions) and Cryoplan and Fuel Cycle Contracts (eight actions) and the IAS audit on Document Management and Information Security (20 actions) are considered now as fully implemented after their respective follow-ups and therefore are not reported anymore.

One audit is considered as fully implemented by F4E Management and is ready for review by the respective internal auditor:

- **IAC audit of Neutral Beam and Electron Cyclotron Power Supplies and Sources Contracts:** All the actions in response to this audit finalised in 2016 are considered as implemented by F4E, therefore this action plan is ready for review by the auditor.

Five action plans are in the process of being implemented. The detailed status is as follows:

- **IAC audit on Selection and Recruitment:** After the follow-up performed by the IAC at the end of 2017, nine additional recommendations were proposed in order to mitigate the residual risks identified, four very important and five important, all of them accepted by F4E Management. By the end of 2018, F4E Management had implemented four of the nine actions proposed in response to the nine recommendations issued.
- **IAS limited review on Implementation of Procurement Arrangements:** After the follow-up, which was finalised in February 2019, the IAS concluded that out of the five recommendations accepted by F4E Management (out of the six issued by the IAS), three had been effectively implemented but two had not been adequately and effectively

implemented. However, the IAS assessed that, in view of the actions already taken, their priority is downgraded from 'very important' to 'important'. F4E will implement both recommendations by the end of 2019.

- **IAC audit of In-Vessel Contracts:** The IAC issued ten recommendations, all of them accepted by F4E Management, seven very important and three important. F4E submitted an action plan with 43 actions, 42 of which were already implemented by the end of 2018.
- **IAC audit on Technical Support Services:** The final report issued by IAC in June 2018, resulted in eight recommendations, all of them accepted by the F4E Management (two very important and six important). F4E submitted an action plan with 16 actions, three of which were already implemented by the end of 2018.
- **IAC audit on Broader Approach Agreement:** The IAC issued the final report of the audit in October 2018. The report highlighted achievements and several areas of strengths in the management of the BA activities and projects. The weaknesses detected are mainly in the area of internal controls, processes and project management. Eight recommendations were issued (all accepted by the F4E Management) of which two are very important, five important and one desirable. F4E management proposed an action plan with nine actions. By the end of 2018, three of these actions were already implemented.

Overview per Criticality of Actions

	In Progress	Implemented	Cancelled	Obsolete	Totals	Implemented %
Critical	0	5	0	0	5	100.00%
Very Important	9	73	4	0	86	84.88%
Important	21	37	1	1	60	61.67%
Desirable	0	1	0	0	1	100.00%
Totals	30	116	5	1	152	79.45%
	19.74%	76.32%	3.29%	0.66%		

Table 26: Implemented % is equal to the number of actions implemented per total number of actions that can be executed (Cancelled and Obsolete actions are not taken into account)

It has to be noted that no critical recommendation has been issued since 2015.

The Process and Organisational Unit continued to report in a timely manner to F4E Management and stakeholders on the status of implementation of audit actions, monitored with the RAPID tool. RAPID has been enhanced in 2018 in order to send alerts to the respective action owners, supporting them in the planning and implementation of their audit activities.

2.10 Follow-up of Observations from the Discharge Authority

For the financial year 2016, the European Parliament (EP) granted, in its plenary session of April 2018, the Discharge in respect of the implementation of the budget to F4E and the closure of its

accounts[17]. They issued 28 observations with regards some aspects of the project, in particular in relation to the 'Emphasis of Matter' of the European Court of Auditors raising concerns on the cost and schedule risks of F4E and the ITER Project.

F4E submitted in July 2018 a report to the EP on the measures taken in the light of the observations accompanying the EP's discharge decision for 2016, in accordance with Article 110 of the F4E Financial Regulation. Out of the 28 observations of the European Parliament, 19 were reported as 'No Action' required from F4E, and the remaining nine were reported as 'Implemented'.

[17] *http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//NONSGML+TA+P8-TA-2018-0171+0+DOC+PDF+V0//EN*

Part II. (b) External Evaluations

The April 2018 Council Conclusions on the reformed ITER project state that “the independent annual assessments of the progress of ITER have to be continued and intensified with a focus on the performance and project management, including cost containment, schedule project control as well as risk management”.

In order to meet the Council request for an enhanced annual assessment, the Governing Board instructed F4E to contract four independent experts to form the panel of the 2018 (7th) annual assessment of F4E. From August to December, the experts reviewed many documents and conducted a number of interviews during visits to F4E’s offices, the ITER Organization and elsewhere. The Final Report was received by the Governing Board in December 2018.

In their executive summary, the assessors acknowledged that progress has been achieved in many areas, notably with the introduction of the enterprise project control system (EcoSys), which allows a “better knowledge and coordination of the advancement of the projects and aspects of the payments and commitment situation.” The Panel also recognised the advancements made on Nuclear Safety and identified areas for improvement in the fields of cost containment, schedule control and risk management.

In total, the assessors put forward a total of 19 recommendations, nine of which pertain to the domains of Nuclear Safety, Cost Containment, Schedule Control and Risk Management, and ten further recommendations regard the follow-up of the 2017 assessment exercise.

F4E prepared an action plan in response to the recommendations in early 2019 which is being reviewed by the Governance bodies of F4E at the time of writing.

Part III. Assessment of the Effectiveness of the Internal Control Systems

3.1 Risk and Opportunity Management

The Integrated Management System (IMS) and its Standards (MS) provide the basis for the Risk Management framework at F4E. Management Standard #8 (MS-8) specifies that F4E has a system to manage risks at both corporate and project level. In particular, F4E performs regular risk analyses at project and corporate level, proposes mitigating actions and monitors and reports on their implementation. Corporate risks considered "critical" are closely followed-up by F4E Management and reported to the Governing Board.

The process to identify, assess and monitor risks was approved by F4E in July 2012 and updated in 2017. It is based on the “market standard” process for risk management, customised to F4E needs. The risks included in the F4E Risk Register have been evaluated with a qualitative and quantitative assessment in the following categories: Cost impact, Schedule impact, Technical impact and Impact on Key External Stakeholders.

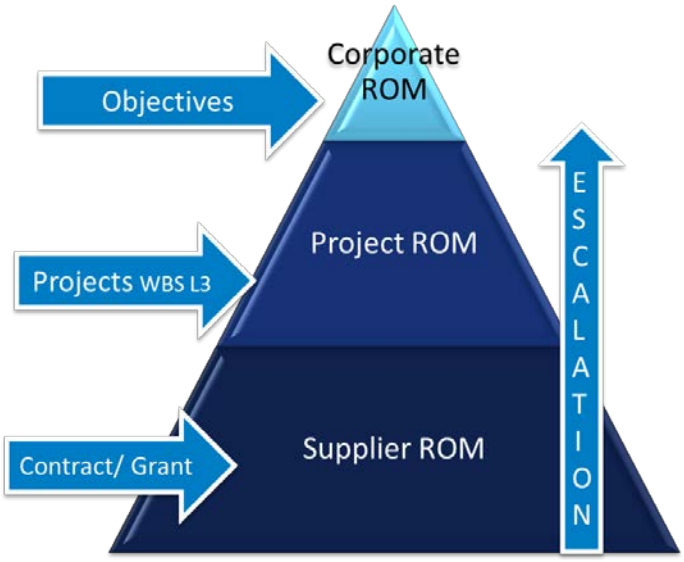


Figure 35: Risk & Opportunity Management Framework

In 2018 this information was reviewed on a quarterly basis for corporate risk and opportunities and on a monthly basis for the project level. The supplier risk registers are reviewed as deliverable of the existing contracts, and taken into account during the monthly update at project level.

For all updates to the risk register, both at corporate and project level, the policy on F4E risk tolerance is considered when deciding the most relevant action plan on a risk-by-risk basis.

Once the monthly update is completed, the ITER Project relevant risks are shared with the ITER Organization for composing the ITER Project risk register and for discussing possible mitigation actions for shared risks at ITER Project level.

It should also be mentioned that, during 2018, eight sessions of Risk and Opportunity Management training took place in order to improve the common F4E culture on risk and opportunity management.

3.2 Compliance and Effectiveness of Management Standards

The latest version of the F4E Management Standards adopted by the Governing Board at the end of 2018 provide the framework for the F4E Integrated Management System by integrating the ISO-9001 quality requirements, the European Commission Internal Control Framework and the ITER project quality and safety requirements. The F4E Management Standards on which the assessment for 2018 was based were those adopted in 2016 as in previous years.

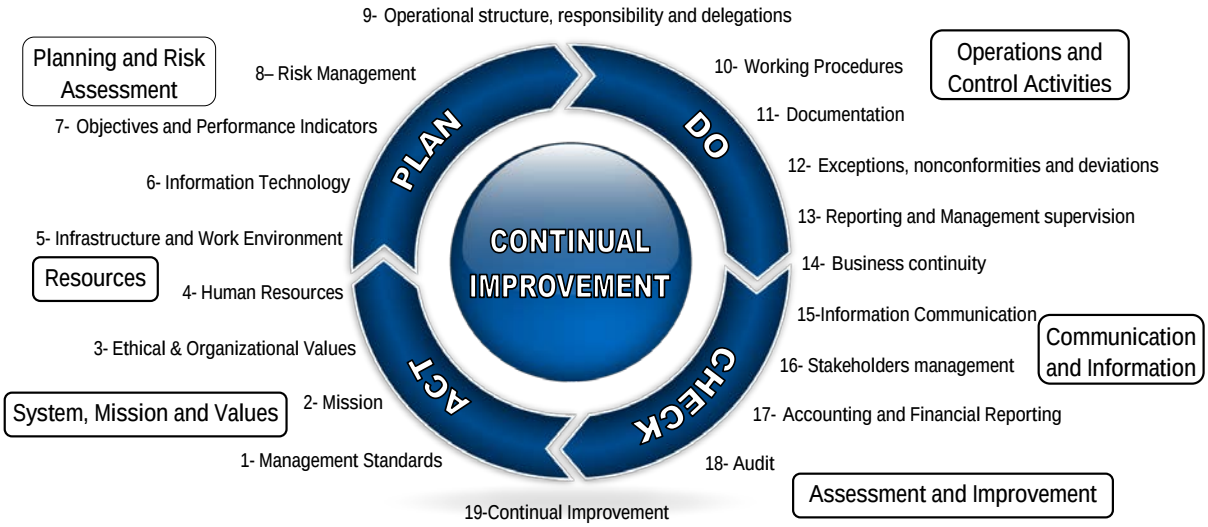


Figure 36: F4E Management Standards 2016

In last year's Annual Activity Report, F4E concluded that the Management Standards were, in accordance with the information and data assessed at the time, effectively implemented in F4E, with improvements necessary for some standards or their requirements. The different actions undertaken during 2018 in order to strengthen the prioritised standards were the following:

- Mandatory training for all staff on Ethics and Compliance, which improved the awareness of staff on the F4E Integrated Management System and in particular on the different elements of internal control at F4E: MS 8 Risk Management, MS 15 Communication, MS 18 Audit and MS 19 Continual improvement;
- Finalisation of the implementation of the Business Continuity Plan: MS 14 Business Continuity;
- Timely implementation of the audit actions on 'Document Management and Information Security' and enhancement of HR activities through a dedicated improvement project: MS 11 Documentation and MS 4 Human Resources.

At the beginning of 2019, an overall assessment of the implementation of the standards was performed as this is one of the elements considered in the 'Declaration of Assurance of the Authorising Officer'. This assessment consisted first on an analysis of the audit recommendations (Internal Audit Service and Internal Audit Capability) and observations (European Court of Auditors) still open at the end of 2018, grouped by impacted standard, and considering the level of risks

involved. Secondly, at the beginning of 2019, F4E re-launched a similar questionnaire as in 2018 whose purpose was to:

- Obtain feedback on how well the Management Standards are known, understood and effectively implemented in the organisation;
- Assess progress on the prioritised standards for 2018;
- Raise awareness of the Management System and its Standards.

The results of this assessment have been categorised into strengths and enhancements, detailed here below.

Strengths

Higher overall results were evident for MS 8 Risk Management, MS 15 Communication, MS 18 Audit and MS 19 Continual improvement for which awareness-raising and training actions were implemented.

The results of the assessment confirmed that progress had been made in the effective implementation of MS 14 Business Continuity, a standard that had been prioritised for two consecutive years (2017 and 2018).

Other standards showed good progress in the frame of continual improvement activities, building on improvement projects and actions launched in previous years and those stemming from the Staff Engagement Survey and the F4E Strategic Action Plan: MS 5 Infrastructure and Work Environment, MS 7 Objectives and Performance Indicators, MS 9 Operational Structure, responsibilities and delegations, MS10 Working procedures and MS 11 Documentation.

Two standards showed continued high results from one year to the next: MS 2 Mission and MS 6 Information Technology.

Enhancements

Those areas which demonstrated the need for some further enhancement were linked to specific requirements, and never the entire Standard. The overall assessment also confirmed areas to prioritise already identified by other internal controls and results of audits. In 2019, F4E will therefore address the improvements to the Integrated Management System with the following horizontal actions impacting simultaneously on several standards:

- On a needs-basis targeted awareness-raising and training via the appropriate communication channels to enhance the following standards: MS 15 Communication, MS 3 Ethics and Organisational Values, MS 4 Human Resources, MS 7 Objectives and Performance Indicators and MS 9 Operational Structure, responsibility and delegations.
- Putting focus on the requirements that have been identified as needing enhancement through the implementation of audit actions, continuation of improvement actions and projects in the following areas: MS 4 Human Resources, Working Procedures, PCR management as well as the accuracy on data related to Asset management. This will have an impact on MS 4 Human Resources, MS 10 Working Procedures, MS 13 Reporting and Management Supervision and 17 Accounting and Financial Reporting.
- Targeted action identified by Management linked to the Staff Engagement Survey results and the F4E Strategic Action plan (cross-cutting impact – see section 3.2.1 Organisational Improvement).

To conclude, the overall assessment has shown the benefits of the improvement actions carried out in 2018 and the enhanced coordination of addressing audits. It has also been used to support the overall analysis for proposing the areas of improvement for 2019. F4E continues to take a more structured approach towards improvement which is further explained in the section 3.2.1 Organisational Improvement. In any case, further enhancing the effectiveness of the F4E internal control system in place, by *inter alia* taking into account any control weaknesses reported, is an ongoing effort in line with the principle of continual improvement of the F4E Integrated Management System, MS 19 Continual Improvement.

3.2.1 Organisational Improvement

Improvement Framework

An F4E Improvement Steering Committee (ISC) was set up in November 2016 continued its work throughout 2018 to prove its ability to align Management views on improvement priorities and objectives. It is also ensured that the appropriate resources and conditions are in place to successfully achieve what is intended and monitors the improvement projects' deliverables provided by the improvement projects to ensure they meet the objectives. Results are measured over a certain period with key performance indicators reported to the Improvement Steering Committee to confirm the positive trends and take corrective actions if needed. The ISC is chaired by the Director and composed of all Heads of Department with the support of the Process and Organisational Improvement Unit (POI). The Head of the Internal Audit Capability also participates as an observer.

The ISC also deals with improvements and efficiency of the F4E Integrated Management System identifying the weaknesses to address in the system itself and adopting the methods to support the improvement of F4E's activities.

In 2017, F4E introduced the 'Lean Six Sigma' methodology to guide the organisation in the way it conducts its improvement projects, in particular applying the DMAIC phases which promotes a fact based approach starting from a clear definition of the project boundaries, selecting indicators (KPI) that are adequate to measure the benefits and performing analysis on issues and requirements before elaborating a solution that fits the purpose. It analyses KPIs to measure the performance of an activity at a given point in time before taking any action and to measure the progress made as a result of improvement actions.

The ISC also deals with improvements and efficiency of the F4E Integrated Management System identifying the weaknesses to address in the system itself and adopting the methods to support the improvement of F4E's activities.

The Business Process Management (BPM) frame was rolled out during 2018 further reinforcing reinforced the process development approach, enhancing efficiency of F4E activities, and aligning IT tool developments and prioritisation. An assessment was made of all working procedures available by area jointly with the Senior Management team who contributed to the definition of the revised framework of activities in process groups, the assignment of process maturity levels to each activity and in the identification of improvement priorities in BPM Rolling plans.

Improvement Projects

The following improvement projects, launched in 2018 or continued from previous years in the frame of the ISC (some applying the 'Lean Six Sigma' methodology), have shown good progress and

some have been completed. In 2018, F4E continued to advance in several areas of improvement identified in previous years.

- Two projects closed in 2017 'Financial Planning Tool' (Ecosys) and Mechanism of Estimate at Completion' were monitored during 2018 to ensure that the expected objectives were achieved.
- The project of the DACC Tool which manages Deviations, Amendments and Contract Changes, continued to be monitored and had additional modules developed in 2018.
- 'Improve Recruitment and Selection' project identified a series of improvement actions which were tested in a pilot phase with good results and will now be rolled out.
- An improvement plan to address the key root causes for the project 'Reduce Schedule Delays' project was started in 2018 and will provide its conclusions in 2019.

The following improvement projects were delivered in 2018 and will be monitored throughout 2019.

- 'Integrating F4E Change Control' reinforced the mechanism to thoroughly track all types of changes (scope, cost and schedule) and assessment of interrelated impacts;
- 'Lead time on operational procurement' streamlined the activities from the launch of a call to the contract signature reducing the overall number of days for the open procedure up to € 2m. Measures will then be applied to all procedures when fully tested;
- 'Financial and operational roles and responsibilities in the approval flow' split into three subprojects (Procurement Arrangement, Contract management and Costing activities). The definition of the financial controlling will be implemented into the related processes.
- 'Document Management' which was delivered in 2018 efficiently addressing audit recommendations on the subject.

In early 2019, the ISC also adopted the following new improvement projects:

- The development of a tool to efficiently track all Project Change Requests (PCR) on the scope deriving from ITER IO. This will complement all the improvement actions implemented by the 'Integrated change control' project;
- Several improvement initiatives are also being initiated by the ITER Delivery Department following the appointment of the new Head of Department, to implement the new vision of project delivery and reinforce some project management activities.

The work coordinated by the ISC feeds into the reporting on the F4E Strategic Action Plan which is presented to the Governing Board.

Staff Engagement Survey follow-up

Since 2014 and on a rolling two-year basis, F4E runs staff engagement surveys, aimed at giving employees a platform for structured feedback, on what is going well but also where the organisation might have blind spots and where improvements are needed. The survey was open to 439 staff members between 12 and 21 September 2018. In total, 331 responses were received, this gives an overall response rate of 75 %, 8 p.p. lower than in 2016 but 19 p.p. higher than in 2014. At the beginning of 2019, eight improvement areas to tackle the Staff Engagement Survey results were identified by Management.

F4E Strategic Action Plan

Finally, in relation to the Strategic Action Plan of F4E, which responds to its Annual Assessments (see Part II. (b) External Evaluations) but also includes own-initiative actions, there was steady progress in the completion of actions including already half of the actions stemming from the 2017 annual assessment. In particular, several actions have been implemented in the area of staff engagement and the integration of staff working at Cadarache. As of November 2018, F4E has completed 72 % of the actions, of which 10 % are subject to continuous improvement and 27 % are in progress. All actions from the original 2015 plan are “Complete” or “Complete and subject to continuous improvement”. Five main areas showed progress:

- ITER Project Performance
- Core Process Improvement, such as Nuclear safety and Quality Assurance and Control
- Organisational Capacity and Efficiency
- Staff Engagement
- Stakeholders Relations

F4E aims to continue with the same momentum throughout 2019, establishing an even closer coordinated approach for all of its improvement projects, actions and initiatives, taking onboard Staff Engagement survey results and moving forward with its Strategic Action plan which is reported to the Governing Board.

Part IV. Management Assurance

4.1 Review of the Elements supporting the Assurance

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

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

The detailed outcome of these different assurance functions has been described in detail in sections Part II and III of this report.

4.2 Reservations

No reservation is entered for 2018.

4.3 Overall Conclusions on Assurance

In conclusion, F4E Management has reasonable assurance that, overall, suitable controls are in place and function as intended; risks are being appropriately monitored and mitigated and continual improvements are being implemented. The F4E Director, in his capacity as Authorising Officer, has signed the Declaration of Assurance without reservation and reported on the major risks the F4E Management is addressing through mitigating actions.

Part V. Declaration of Assurance

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

- State that I have reasonable assurance that:
  - the information contained in this report presents a true and fair view;
  - the resources assigned to the activities described in this report have been used for their intended purpose and in accordance with the principles of sound financial management;
  - the control procedures put in place give the necessary guarantees concerning the legality and regularity of the underlying transactions related to the 2018 annual accounts.

  This reasonable assurance is based on my own judgment and on the information at my disposal, such as the observations of the European Court of Auditors (ECA), the Internal Audit Service and the Internal Audit Capability, the declarations of the Authorising Officers by Delegation and Sub-Delegation, the results of the F4E corporate supervision functions, the ex-post controls on grants and the annual assessment of F4E.
- Without qualifying this reasonable assurance, I would like to highlight the risks observed by the ECA in the "Emphasis of Matter" section of their 2017 Annual Report: *"While positive steps have been taken to improve the management and control of the ITER project construction phase, there remains a risk of further cost increases and delays in project implementation compared to the new proposed baseline"*.
- I confirm that the risks F4E is facing do not call into question the legality and regularity of the underlying transactions in relation to the 2018 annual accounts. F4E is addressing them through implementation of mitigating actions to address the most significant risks in the ITER in-kind delivery projects, in particular the buildings, the vacuum vessel and the magnets. F4E is closely monitoring the cost estimates and project risks to ensure that the current MFF[18] budget cap until 2020 is respected;
- I believe that the actions noted above, as well as the continuous improvement programme in 2018 and before will significantly enhance F4E's project performance. Nevertheless, I concur with the highlighted observation of the ECA that, as inherent to a project of that magnitude, there remains a risk of further cost increases and schedule delays that the ITER council, the F4E Governing Board and F4E management are addressing.
- I confirm that I am unaware of any additional information which has not been reported here and which could harm the interests of F4E and the European institutions in general.

Johannes P. Schwemmer

Director

8 May 2019

[18] *Multi-annual Financial Framework (http://ec.europa.eu/budget/mff/index2014-2020_en.cfm)*

Annexes

Annex I. Core Business Statistics

Introduction

F4E has identified specific Key Performance Indicators (KPI) in order to measure how effectively the organisation achieves the target set in different project (i.e. schedule, cost, risk, etc.) and programmatic areas (i.e. annual budget consumption, quality, etc.). F4E updates these KPIs on a monthly basis and reviews them at the level of its Senior Management and take action to address events or risk that could threaten their achievement.

For the European contributions to ITER, the basis for the adopted KPIs is the F4E current baseline, in schedule, cost and budget. F4E ensures that the current baseline is maintained through change control processes together with the ITER Organization. Dashboards are available with the possibility of drilling down for more details, both at a global F4E level and individually per Project Team. KPIs information is included in many F4E documents and reports to its governing bodies.

"Technical" Indicators

In relation to F4E's obligation to provide in kind contributions to the **ITER Project**:

- The ITER Council approves, monitors and updates a set of high-level monitoring milestones – the so-called **ITER Council (IC) milestones**, which track the overall progress of the project in all the seven ITER Domestic Agencies (including F4E) and the ITER Organization. These milestones are suitable for tracking progress as they cover a larger group of components at different stages of their development. Most of them are key to achieve the ITER First Plasma, but some of them also relate to non-First Plasma systems;
- To complement the ITER Council milestones, an expanded set of high-level milestones are approved, monitored and updated by F4E's Governing Board – the **Governing Board (GB) milestones** which are solely applicable to F4E. Their status is reported to F4E's Governing Board and other governance bodies on a monthly basis and subject to change control by the Governing Board. The complete list of F4E's Governing Board and ITER Council milestones for 2018 is provided in F4E's Multi-annual and Annual Programme document (MAP);
- In addition, F4E uses a basket of **additional technical milestones** to monitor more precisely its own performance. F4E has selected such milestones by making sure that they cover important activities inside the organization and therefore can provide a meaningful measure of F4E performance. These include Procurement Arrangement signatures, commitments >€ 2m, Calls for tender, contract signatures >€ 2m and project execution milestones;
- Taking the above three types of milestones, which amount to some 175 milestones for 2018 (shown in Table 27 below), one can infer a **Schedule Performance Index (SPI)** that measure the performance of F4E according to the number of milestones achieved during the year compared with the amount initially forecasted (baseline of the year). The Schedule Performance Index is calculated on the basis of a moving annual average which is reviewed on a monthly basis by F4E's Senior Management and reported regularly to its Governing Board;

Type	Abbreviation	Description	Baseline
ITER Council and Governing Board Milestones	IC/GB	Milestones against which the ITER Council and Governing Board will measure the project.	F4E Current Baseline
PA Signature	PA Sig	Signatures of PAs. ITA signatures and PA amendment signatures are not included.	F4E Current Baseline
Call for Tender	CfT	Publication of a Call for Tender.	F4E Current Baseline
Contract, Grant, Specfic Contract or Specific Grant Signature above 2 Meuro	C/G/TO Sig	Signatures of new Direct Contracts, Grants, Specific Contracts and Specific Grant with value above 2 million Euros. Amendments are not included.	F4E Current Baseline
Commitments above 2 million Euros	Com >2ME	Any commitment above 2 million Euros.	F4E Current Baseline
Project Execution Milestones	Exec	Milestone in the on-going execution of a project. These milestones were selected by the project teams at the end of the previous year.	F4E Current Baseline

Table 27: Technical objectives and KPIs used for monitoring purposes

- While milestone analysis provides indications of performance, it does not take into account the importance of milestones. This is why F4E also employs **Earned Value Management** using the so-called 'ITER credits'. The ITER Organization and each Domestic Agency agree a credit profile as part of each Procurement Arrangement to measure the value achieved as the work progresses. This allows a comparison of the achieved ITER credit against the plan for all the ITER systems that F4E is working on. These so-called **Credit Allocation Scheme (CAS) milestones** are tracked by F4E in terms of the time taken between achievement of the milestone and the award of the credit by the ITER Organization. This indicator is important as delays in the award of ITER credit can appear as an underperformance by F4E;
- To monitor projects against their budgets, the **Estimate at Completion (EAC)** is calculated by F4E on a monthly basis using three elements (a) actual costs already incurred, (b) estimate of future costs, (c) estimate of likely impact of future risks. F4E follows an industry standard process for its EAC. The monthly update process is complemented by biannual deep-dive reviews to assess in more detail the quality of the estimates and the associated assumptions at programme and project level. F4E systematically presents the EAC at each biannual Governing Board meeting.

Contributions to **Broader Approach (BA) projects** are formalised under Procurement Arrangements between F4E and the Japanese Implementing Agency (QST), which in turn are backed by Agreements of Collaboration between F4E and institutions chosen by the Voluntary Contributors. The accounting of contributions is tracked by an Earned Value Management approach using credits. In addition, the Broader Approach projects are monitored by the achievement on time of the milestones defined in the Project Plan approved by the Broader Approach Steering Committee. The complete list of F4E's Broader Approach milestones for 2018 are provided in F4E's

MAP. Each of these milestones is assigned a credit value that is used to allow an Earned Value calculation of the overall level of achievement against the Planned Value.

"Non-Technical" Indicators

Despite the fact that F4E is an organisation with obvious technical objectives, F4E acknowledges that the same attention shall be granted to other relevant tasks that are non-technical but still very important for the organisation to run smoothly. They are then translated into objectives to be achieved by the organisation. The Non-Technical Objectives and their KPIs are shown in Table 28. They are Corporate Objectives and for this reason they are related both to ITER and Broader Approach projects. The calculation methodology for these milestones is explained in F4E's MAP.

AREA	OBJECTIVE
Overall Costs	- Cost estimation until 2020 should be less than total budget available until 2020
Annual budget	- Implementation of Annual budget achieved [100%]
Annual payment	- Implementation of payment fully achieved. [100%]
Quality	- To reduce the number of Long Non Conformity Report (NCRs) compared to the previous year. IO defines Long NCRs the ones open for more than 180 Days. NCRs to be closed in less than 9 months on average
Human Resources	- Staff Turnover rate should be less than < 4%

Table 28: Non-technical objectives and KPIs used by F4E

Other "non-technical" indicators but for which targets are not currently set but are monitored internally and, in some cases, reported on a biennial basis to F4E's Governing Board, include the staff attrition rate, gender balance, time to place contracts and grants and time to recruit.

To ensure the widespread awareness of F4E's performance against the above technical and non-technical objectives, F4E has created a 'dashboard' showing the most important KPIs which is not only used for monthly reporting to the Project Steering Meeting and stakeholders but also shown on screens located on every floor of F4E's offices at the Barcelona headquarter offices.

Annex II. Statistics on Financial Management

Annex II. a. Statistics on Financial Management Budget – Budget Execution

Implementation of the Statement Expenditure in Commitment Appropriations (EUR)

Heading of the 2018 Budget	Commitment Appropriation		
	Final budget for implementation (1)	Final implementation (2)	% implementation (3)= (2)/(1)
CH 11 - STAFF EXPENDITURE IN THE ESTABLISHMENT PLAN	32 627 937.03	32 627 937.03	100.0%
CH 12 - EXTERNAL STAFF EXPENDITURE (CA, IS AND SNE)	10 597 575.36	10 597 575.36	100.0%
CH 13 - MISSIONS AND DUTY TRAVEL	1 815 000.00	1 815 000.00	100.0%
CH 14 - MISCELLANEOUS EXPENDITURE ON STAFF RECRUITMENT AND TRANFER	644 755.51	644 755.51	100.0%
CH 15 - REPRESENTATION	10 000.00	10 000.00	100.0%
CH 16 -TRAINING	630 940.00	630 940.00	100.0%
CH 17 - OTHER STAFF MANAGEMENT EXPENDITURE	2 808 000.00	2 808 000.00	100.0%
CH 18 - TRAINEESHIPS	127 316.91	127 316.91	100.0%
TITLE 1 Staff expenditure	49 261 524.81	49 261 524.81	100.0%
CH 21 - BUILDINGS AND ASSOCIATED COSTS	1 870 839.68	1 381 500.00	73.8%
CH 22 - INFORMATION AND COMMUNICATION TECHNOLOGIES	3 490 812.69	3 490 812.69	100.0%
CH 23 - MOVABLE PROPERTY AND ASSOCIATED COSTS	157 705.00	157 705.00	100.0%
CH 24 - EVENTS AND COMMUNICATION	237 150.00	237 150.00	100.0%
CH 25 - OUTSOURCING AND OTHER CURRENT EXPENDITURE	1 064 449.50	1 064 449.50	100.0%
CH 26 - POSTAGE AND TELECOMMUNICATIONS	348 334.72	348 334.72	100.0%
CH 27 - EXPENDITURE ON FORMAL AND OTHER MEETINGS	358 000.00	358 000.00	100.0%
CH 28 - APPROPRIATION ACCRUING FROM THIRD PARTIES TO THE BUILDING REFURBISHMENT EXPENDITURE	0.00	0.00	-
TITLE 2 -	7 527 291.59	7 037 951.91	93.5%
Total TITLE 1 & 2	56 788 816.40	56 299 476.72	99.1%
CH 31 - ITER CONSTRUCTION INCLUDING ITER SITE PREPARATION	454 869 854.88	454 717 178.33	100.0%
CH 32 - TECHNOLOGY FOR ITER	9 083 632.35	9 083 632.35	100.0%
CH 33 - TECHNOLOGY FOR BROADER APPROACH AND DEMO	3 602 145.19	3 602 145.19	100.0%
CH 34 - OTHER EXPENDITURE	6 738 702.02	6 726 502.02	99.8%
CH 35 - ITER CONSTRUCTION - APPROPRIATIONS ACCRUING FROM THE HOST STATE CONTRIBUTION	160 941 939.90	160 941 939.90	100.0%
CH 36 - APPROPRIATION ACCRUING FROM THIRD PARTIES TO SPECIFIC ITEM OF EXPENDITURE	14 205 141.03	3 614 631.65	25.4%
TITLE 3	649 441 415.37	638 686 029.44	98.3%
Total implementation	706 230 231.77	694 985 506.16	98.4%

Implementation of the Statement of Expenditure in Payment Appropriations(EUR)

Heading of the 2018 Budget	Payment Appropriation				
	Final budget for implementation (1)	On B 2018 commitments (2)	On B 2017 commitments (3)	Final implementation (4)=(2)+(3)	% implementation (5)= (4)/(1)
CH 11 - STAFF EXPENDITURE IN THE ESTABLISHMENT PLAN	**32 627 937.03**	32 627 937.03	0.00	**32 627 937.03**	**100.0%**
CH 12 - EXTERNAL STAFF EXPENDITURE (CA, IS AND SNE)	**10 836 366.66**	10 387 303.62	111 659.52	**10 498 963.14**	**96.9%**
CH 13 - MISSIONS AND DUTY TRAVEL	**2 538 637.91**	524 758.41	719 992.13	**1 244 750.54**	**49.0%**
CH 14 - MISCELLANEOUS EXPENDITURE ON STAFF RECRUITMENT AND TRANFER	**763 293.52**	596 676.81	48 833.70	**645 510.51**	**84.6%**
CH 15 - REPRESENTATION	**12 091.77**	3 635.23	0.00	**3 635.23**	**30.1%**
CH 16 -TRAINING	**884 920.44**	413 264.52	153 529.72	**566 794.24**	**64.1%**
CH 17 - OTHER STAFF MANAGEMENT EXPENDITURE	**3 013 674.21**	2 452 613.13	152 381.48	**2 604 994.61**	**86.4%**
CH 18 - TRAINEESHIPS	**149 244.64**	127 316.91	0.00	**127 316.91**	**85.3%**
TITLE 1 Staff expenditure	**50 826 166.18**	**47 133 505.66**	**1 186 396.55**	**48 319 902.21**	**95.1%**
CH 21 - BUILDINGS AND ASSOCIATED COSTS	**2 490 094.48**	801 754.25	481 615.17	**1 283 369.42**	**51.5%**
CH 22 - INFORMATION AND COMMUNICATION TECHNOLOGIES	**4 245 827.16**	1 647 247.80	670 376.78	**2 317 624.58**	**54.6%**
CH 23 - MOVABLE PROPERTY AND ASSOCIATED COSTS	**327 432.86**	53 024.78	102 414.31	**155 439.09**	**47.5%**
CH 24 - EVENTS AND COMMUNICATION	**352 250.67**	155 234.15	44 895.25	**200 129.40**	**56.8%**
CH 25 - OUTSOURCING AND OTHER CURRENT EXPENDITURE	**1 513 948.43**	685 013.75	274 802.17	**959 815.92**	**63.4%**
CH 26 - POSTAGE AND TELECOMMUNICATIONS	**598 700.98**	152 049.56	137 543.83	**289 593.39**	**48.4%**
CH 27 - EXPENDITURE ON FORMAL AND OTHER MEETINGS	**533 454.83**	209 848.43	136 341.00	**346 189.43**	**64.9%**
CH 28 - APPROPRIATION ACCRUING FROM THIRD PARTIES TO THE BUILDING REFURBISHMENT EXPENDITURE	**0.00**	0.00	0.00	**0.00**	**-**
TITLE 2 -	**10 061 709.41**	**3 704 172.72**	**1 847 988.51**	**5 552 161.23**	**55.2%**
Total TITLE 1 & 2	**60 887 875.59**	**50 837 678.38**	**3 034 385.06**	**53 872 063.44**	**88.5%**
CH 31 - ITER CONSTRUCTION INCLUDING ITER SITE PREPARATION	**611 183 522.93**	**-**	**-**	**601 329 468.31**	**98.4%**
CH 32 - TECHNOLOGY FOR ITER	**7 871 073.36**	**-**	**-**	**7 871 073.36**	**100.0%**
CH 33 - TECHNOLOGY FOR BROADER APPROACH AND DEMO	**8 147 792.42**	**-**	**-**	**8 147 792.42**	**100.0%**
CH 34 - OTHER EXPENDITURE	**3 977 146.73**	**-**	**-**	**3 977 146.73**	**100.0%**
CH 35 - ITER CONSTRUCTION - APPROPRIATIONS ACCRUING FROM THE HOST STATE CONTRIBUTION	**131 516 602.86**	**-**	**-**	**129 318 457.43**	**98.3%**
CH 36 - APPROPRIATION ACCRUING FROM THIRD PARTIES TO SPECIFIC ITEM OF EXPENDITURE	**23 782 974.27**	**-**	**-**	**9 471 448.93**	**39.8%**
TITLE 3	**786 479 112.57**	**-**	**-**	**760 115 387.18**	**96.6%**
Total implementation	**847 366 988.16**	**-**	**-**	**813 987 450.62**	**96.1%**

Annex II. b. Statistics on Financial Management Budget – Evolution of the Budget

Evolution of the budget

(EUR)

2018 Statement of Expenditure (EUR)		Initial Budget 2018		Amendment N°1		Amendment N°2		Internal Transfers		Final Budget 2018	
Title Chapter	Heading	Commitments	Payments	Commitments	Payments	Commitments	Payments	Commitments	Payments	Commitments	Payments
1	**STAFF EXPENDITURE**										
11	STAFF EXPENDITURE IN THE ESTABLISHMENT PLAN	29 283 030.32	29 283 030.32			791 474.19	791 474.19	2 553 432.52	2 553 432.52	32 627 937.03	32 627 937.03
12	EXTERNAL STAFF EXPENDITURE (CONTRACT AGENTS, INTERIM STAFF AND NATIONAL EXPERTS)	10 744 000.00	10 744 000.00					- 147 211.98	- 147 211.98	10 596 788.02	10 596 788.02
13	MISSIONS AND DUTY TRAVEL	1 400 000.00	1 400 000.00					415 000.00	415 000.00	1 815 000.00	1 815 000.00
14	MISCELLANEOUS EXPENDITURE ON STAFF RECRUITMENT AND TRANSFER	1 137 000.00	1 137 000.00					- 492 244.49	- 492 244.49	644 755.51	644 755.51
15	REPRESENTATION	10 000.00	10 000.00					0.00	0.00	10 000.00	10 000.00
16	TRAINING	831 000.00	831 000.00					- 200 060.00	- 200 060.00	630 940.00	630 940.00
17	OTHER STAFF MANAGEMENT EXPENDITURE	2 300 000.00	2 300 000.00					508 000.00	508 000.00	2 808 000.00	2 808 000.00
18	TRAINEESHIPS	148 000.00	148 000.00					- 20 683.09	- 20 683.09	127 316.91	127 316.91
	Title 1 - Total	**45 853 030.32**	**45 853 030.32**	**0.00**	**0.00**	**791 474.19**	**791 474.19**	**2 616 232.96**	**2 616 232.96**	**49 260 737.47**	**49 260 737.47**
2	**BUILDINGS, EQUIPMENT AND MISCELLANEOUS OPERATING EXPENDITURE**										
21	BUILDINGS AND ASSOCIATED COSTS	1 489 000.00	1 489 000.00					- 107 500.00	- 107 500.00	1 381 500.00	1 381 500.00
22	INFORMATION AND COMMUNICATION TECHNOLOGIES	3 500 000.00	3 500 000.00					- 9 187.31	- 9 187.31	3 490 812.69	3 490 812.69
23	MOVABLE PROPERTY AND ASSOCIATED COSTS	856 050.00	856 050.00					- 698 345.00	- 698 345.00	157 705.00	157 705.00
24	EVENTS and COMMUNICATION	299 000.00	299 000.00					- 61 850.00	- 61 850.00	237 150.00	237 150.00
25	OUTSOURCING AND OTHER CURRENT EXPENDITURE	1 384 000.00	1 384 000.00					- 319 550.50	- 319 550.50	1 064 449.50	1 064 449.50
26	POSTAGE AND TELECOMMUNICATIONS	425 000.00	425 000.00					- 76 665.28	- 76 665.28	348 334.72	348 334.72
27	EXPENDITURE ON FORMAL AND OTHER MEETINGS	314 000.00	314 000.00					44 000.00	44 000.00	358 000.00	358 000.00
28	APPROPRIATION ACCRUING FROM THIRD PARTIES TO THE BUILDING REFURBISHMENT EXPENDITURE	P.M.	P.M.					0.00	0.00	0.00	0.00
	Title 2 - Total	**8 267 050.00**	**8 267 050.00**	**0.00**	**0.00**	**0.00**	**0.00**	**- 1 229 098.09**	**- 1 229 098.09**	**7 037 951.91**	**7 037 951.91**
	Titles 1 & 2 : Administrative expenditure - Subtotal	**54 120 080.32**	**54 120 080.32**	**0.00**	**0.00**	**791 474.19**	**791 474.19**	**1 387 134.87**	**1 387 134.87**	**56 298 689.38**	**56 298 689.38**
3	**OPERATIONAL EXPENDITURE**										
31	ITER CONSTRUCTION INCLUDING THE ITER SITE PREPARATION	393 176 799.00	426 500 000.00	13 535 852.32	159 920 764.00	29 090 222.68		- 3 578 925.43	2 116 852.62	432 223 948.57	588 537 616.62
32	TECHNOLOGY FOR ITER	6 468 000.00	9 000 000.00	832 000.00		- 303 208.00		2 086 840.35	- 1 128 926.64	9 083 632.35	7 871 073.36
33	TECHNOLOGY FOR BROADER APPROACH AND DEMO	6 693 000.00	6 500 000.00	3 970.36		- 2 519 666.36		- 575 158.81	1 647 792.42	3 602 145.19	8 147 792.42
34	OTHER EXPENDITURE	8 477 000.00	8 000 000.00	- 2 451 058.68		32 651.68		680 109.02	- 4 022 853.27	6 738 702.02	3 977 146.73
35	ITER CONSTRUCTION - APPROPRIATION ACCRUING FROM THE ITER HOST STATE CONTRIBUTION	142 000 000.00	130 000 000.00							142 000 000.00	130 000 000.00
36	APPROPRIATION ACCRUING FROM THIRD PARTIES TO SPECIFIC ITEM OF EXPENDITURE	p.m.	p.m.							0.00	0.00
	Title 3: Operational expenditure - Total	**556 814 799.00**	**580 000 000.00**	**11 920 764.00**	**159 920 764.00**	**26 300 000.00**	**0.00**	**- 1 387 134.87**	**- 1 387 134.87**	**593 648 428.13**	**738 533 629.13**
	TOTAL BUDGET	**610 934 879.32**	**634 120 080.32**	**11 920 764.00**	**159 920 764.00**	**27 091 474.19**	**791 474.19**	**0.00**	**0.00**	**649 947 117.51**	**794 832 318.51**

Final available budget for implementation

(EUR)

2018 Statement of Expenditure (EUR)		Final Budget 2018		Additional revenue		Carry over from 2017		Final available 2018 Budget	
Title Chapter	Heading	Commitments	Payments						
1	**STAFF EXPENDITURE**								
1 1	STAFF EXPENDITURE IN THE ESTABLISHMENT PLAN	32 627 937.03	32 627 937.03					32 627 937.03	32 627 937.03
1 2	EXTERNAL STAFF EXPENDITURE (CONTRACT AGENTS, INTERIM STAFF AND NATIONAL EXPERTS)	10 596 788.02	10 596 788.02	787.34	787.34		238 791.30	10 597 575.36	10 836 366.66
1 3	MISSIONS AND DUTY TRAVEL	1 815 000.00	1 815 000.00				723 637.91	1 815 000.00	2 538 637.91
1 4	MISCELLANEOUS EXPENDITURE ON STAFF RECRUITMENT AND TRANSFER	644 755.51	644 755.51				118 538.01	644 755.51	763 293.52
1 5	REPRESENTATION	10 000.00	10 000.00				2 091.77	10 000.00	12 091.77
1 6	TRAINING	630 940.00	630 940.00				253 980.44	630 940.00	884 920.44
1 7	OTHER STAFF MANAGEMENT EXPENDITURE	2 808 000.00	2 808 000.00				205 674.21	2 808 000.00	3 013 674.21
1 8	TRAINEESHIPS	127 316.91	127 316.91				21 927.73	127 316.91	149 244.64
	Title 1 - Total	**49 260 737.47**	**49 260 737.47**	**787.34**	**787.34**	**0.00**	**1 564 641.37**	**49 261 524.81**	**50 826 166.18**
2	**BUILDINGS, EQUIPMENT AND MISCELLANEOUS OPERATING EXPENDITURE**								
2 1	BUILDINGS AND ASSOCIATED COSTS	1 381 500.00	1 381 500.00	489 339.68	489 339.68		619 254.80	1 870 839.68	2 490 094.48
2 2	INFORMATION AND COMMUNICATION TECHNOLOGIES	3 490 812.69	3 490 812.69				755 014.47	3 490 812.69	4 245 827.16
2 3	MOVABLE PROPERTY AND ASSOCIATED COSTS	157 705.00	157 705.00				169 727.86	157 705.00	327 432.86
2 4	EVENTS and COMMUNICATION	237 150.00	237 150.00				115 100.67	237 150.00	352 250.67
2 5	OUTSOURCING AND OTHER CURRENT EXPENDITURE	1 064 449.50	1 064 449.50				449 498.93	1 064 449.50	1 513 948.43
2 6	POSTAGE AND TELECOMMUNICATIONS	348 334.72	348 334.72				250 366.26	348 334.72	598 700.98
2 7	EXPENDITURE ON FORMAL AND OTHER MEETINGS	358 000.00	358 000.00				175 454.83	358 000.00	533 454.83
2 8	APPROPRIATION ACCRUING FROM THIRD PARTIES TO THE BUILDING REFURBISHMENT EXPENDITURE	0.00	0.00					0.00	0.00
	Title 2 - Total	**7 037 951.91**	**7 037 951.91**	**489 339.68**	**489 339.68**	**0.00**	**2 534 417.82**	**7 527 291.59**	**10 061 709.41**
	Titles 1 & 2 : Administrative expenditure - Subtotal	**56 298 689.38**	**56 298 689.38**	**490 127.02**	**490 127.02**	**0.00**	**4 099 059.19**	**56 788 816.40**	**60 887 875.59**
3	**OPERATIONAL EXPENDITURE**								
3 1	ITER CONSTRUCTION INCLUDING THE ITER SITE PREPARATION	432 223 948.57	588 537 616.62	22 458 805.15	22 458 805.15	187 101.16	187 101.16	454 869 854.88	611 183 522.93
3 2	TECHNOLOGY FOR ITER	9 083 632.35	7 871 073.36					9 083 632.35	7 871 073.36
3 3	TECHNOLOGY FOR BROADER APPROACH AND DEMO	3 602 145.19	8 147 792.42					3 602 145.19	8 147 792.42
3 4	OTHER EXPENDITURE	6 738 702.02	3 977 146.73					6 738 702.02	3 977 146.73
3 5	ITER CONSTRUCTION - APPROPRIATION ACCRUING FROM THE ITER HOST STATE CONTRIBUTION	142 000 000.00	130 000 000.00			18 941 939.90	1 516 602.86	160 941 939.90	131 516 602.86
3 6	APPROPRIATION ACCRUING FROM THIRD PARTIES TO SPECIFIC ITEM OF EXPENDITURE	p.m	p.m.	13 646 994.25	13 148 645.00	558 146.78	10 634 329.27	14 205 141.03	23 782 974.27
	Title 3: Operational expenditure - Total	**593 648 428.13**	**738 533 629.13**	**36 105 799.40**	**35 607 450.15**	**19 687 187.84**	**12 338 033.29**	**649 441 415.37**	**786 479 112.57**
	TOTAL BUDGET	**649 947 117.51**	**794 832 318.51**	**36 595 926.42**	**36 097 577.17**	**19 687 187.84**	**16 437 092.48**	**706 230 231.77**	**847 366 988.16**

Transfers on 2018 Budget

(EUR)

2018 Statement of Expenditure (EUR)		Transfer no 1 05/11/2018		Transfer no 2 28/11/2018	Transfer no 3 05/12/2018	Transfer no 4 05/12/2018		Transfer no 5 13/12/2018	Transfer no 6 14/12/2018		Transfer no 7 20/12/2018		Transfer no 8 19/12/2018	Total Transfers	
Title Chapter	Heading	Commitments	Payments	Commitments	Payments	Commitments	Payments	Commitments	Commitments	Payments	Commitments	Payments	Payments	Commitments	Payments
1	**STAFF EXPENDITURE**														
1 1	STAFF EXPENDITURE IN THE ESTABLISHMENT PLAN	100 000.00	100 000.00			3 244 906.71	3 244 906.71		- 791 474.19	- 791 474.19				**2 553 432.52**	**2 553 432.52**
1 2	EXTERNAL STAFF EXPENDITURE (CONTRACT AGENTS, INTERIM STAFF AND NATIONAL EXPERTS)					- 147 211.98	- 147 211.98							**- 147 211.98**	**- 147 211.98**
1 3	MISSIONS AND DUTY TRAVEL					415 000.00	415 000.00							**415 000.00**	**415 000.00**
1 4	MISCELLANEOUS EXPENDITURE ON STAFF RECRUITMENT AND TRANSFER					- 492 244.49	- 492 244.49							**- 492 244.49**	**- 492 244.49**
1 5	REPRESENTATION													**0.00**	**0.00**
1 6	TRAINING					- 200 060.00	- 200 060.00							**- 200 060.00**	**- 200 060.00**
1 7	OTHER STAFF MANAGEMENT EXPENDITURE					508 000.00	508 000.00							**508 000.00**	**508 000.00**
1 8	TRAINEESHIPS					- 20 683.09	- 20 683.09							**- 20 683.09**	**- 20 683.09**
	Title 1 - Total	**100 000.00**	**100 000.00**	**0.00**	**0.00**	**3 307 707.15**	**3 307 707.15**	**0.00**	**- 791 474.19**	**- 791 474.19**	**0.00**	**0.00**	**0.00**	**2 616 232.96**	**2 616 232.96**
2	**BUILDINGS, EQUIPMENT AND MISCELLANEOUS OPERATING EXPENDITURE**														
2 1	BUILDINGS AND ASSOCIATED COSTS					- 107 500.00	- 107 500.00							**- 107 500.00**	**- 107 500.00**
2 2	INFORMATION AND COMMUNICATION TECHNOLOGIES					- 9 187.31	- 9 187.31							**- 9 187.31**	**- 9 187.31**
2 3	MOVABLE PROPERTY AND ASSOCIATED COSTS	- 100 000.00	- 100 000.00			- 598 345.00	- 598 345.00							**- 698 345.00**	**- 698 345.00**
2 4	EVENTS and COMMUNICATION					- 54 850.00	- 54 850.00				- 7 000.00	- 7 000.00		**- 61 850.00**	**- 61 850.00**
2 5	OUTSOURCING AND OTHER CURRENT EXPENDITURE					- 289 778.50	- 289 778.50		- 29 772.00	- 29 772.00				**- 319 550.50**	**- 319 550.50**
2 6	POSTAGE AND TELECOMMUNICATIONS					- 76 665.28	- 76 665.28							**- 76 665.28**	**- 76 665.28**
2 7	EXPENDITURE ON FORMAL AND OTHER MEETINGS					44 000.00	44 000.00							**44 000.00**	**44 000.00**
2 8	APPROPRIATION ACCRUING FROM THIRD PARTIES TO THE BUILDING REFURBISHMENT EXPENDITURE													**0.00**	**0.00**
	Title 2 - Total	**- 100 000.00**	**- 100 000.00**	**0.00**	**0.00**	**- 1 092 326.09**	**- 1 092 326.09**	**0.00**	**- 29 772.00**	**- 29 772.00**	**- 7 000.00**	**- 7 000.00**	**0.00**	**- 1 229 098.09**	**- 1 229 098.09**
	Titles 1 & 2 : Administrative expenditure - Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**2 215 381.06**	**2 215 381.06**	**0.00**	**- 821 246.19**	**- 821 246.19**	**- 7 000.00**	**- 7 000.00**	**0.00**	**1 387 134.87**	**1 387 134.87**
3	**OPERATIONAL EXPENDITURE**														
3 1	ITER CONSTRUCTION INCLUDING THE ITER SITE PREPARATION			- 1 000 000.00	- 3 000 000.00	- 2 215 381.06	- 2 215 381.06	- 2 100 000.00	821 246.19	821 246.19	915 209.44	7 000.00	6 503 987.49	**- 3 578 925.43**	**2 116 852.62**
3 2	TECHNOLOGY FOR ITER							2 100 000.00			- 13 159.65		- 1 128 926.64	**2 086 840.35**	**- 1 128 926.64**
3 3	TECHNOLOGY FOR BROADER APPROACH AND DEMO				3 000 000.00						- 575 158.81		- 1 352 207.58	**- 575 158.81**	**1 647 792.42**
3 4	OTHER EXPENDITURE			1 000 000.00							- 319 890.98		- 4 022 853.27	**680 109.02**	**- 4 022 853.27**
3 5	ITER CONSTRUCTION - APPROPRIATION ACCRUING FROM THE ITER HOST STATE CONTRIBUTION													**0.00**	**0.00**
3 6	APPROPRIATION ACCRUING FROM THIRD PARTIES TO SPECIFIC ITEM OF EXPENDITURE													**0.00**	**0.00**
	Title 3: Operational expenditure - Total	**0.00**	**0.00**	**0.00**	**0.00**	**- 2 215 381.06**	**- 2 215 381.06**	**0.00**	**821 246.19**	**821 246.19**	**7 000.00**	**7 000.00**	**0.00**	**- 1 387 134.87**	**- 1 387 134.87**
	TOTAL BUDGET	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**- 0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Annex II. c. Statistics on Financial Management Budget – Procurement Data

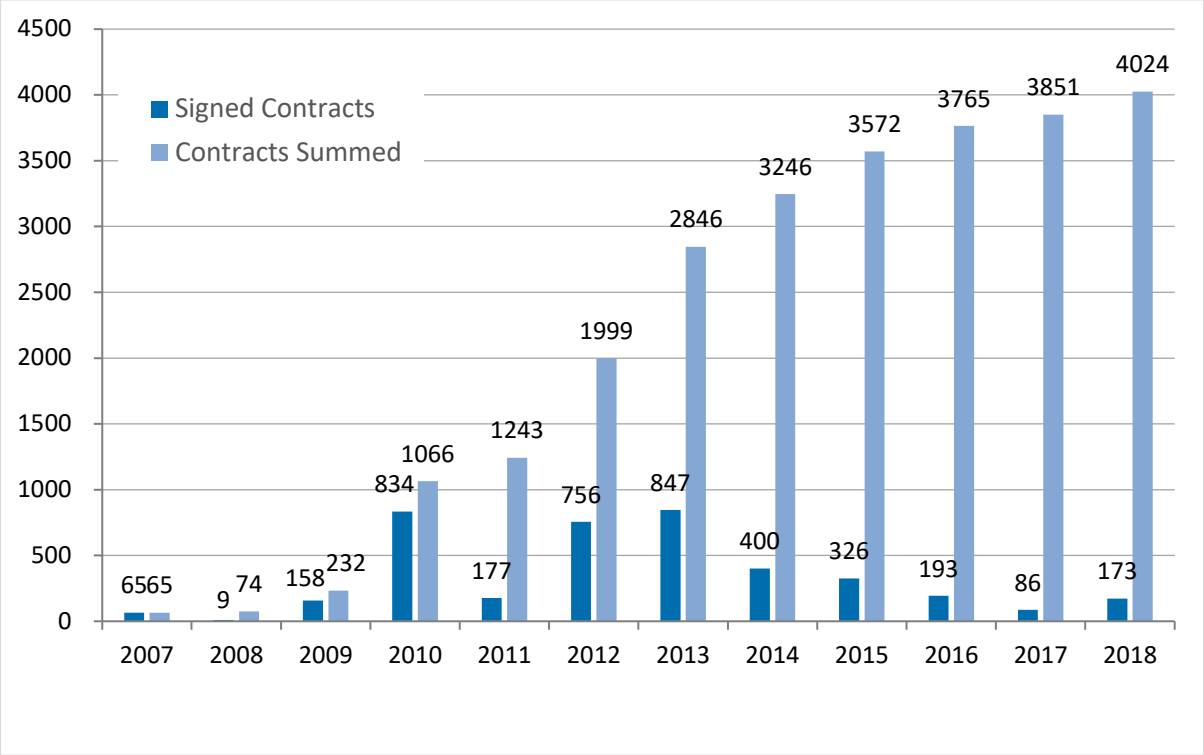


Figure 37: Annual and cumulative value of contracts and grants signed by F4E (€ million, in-year values)

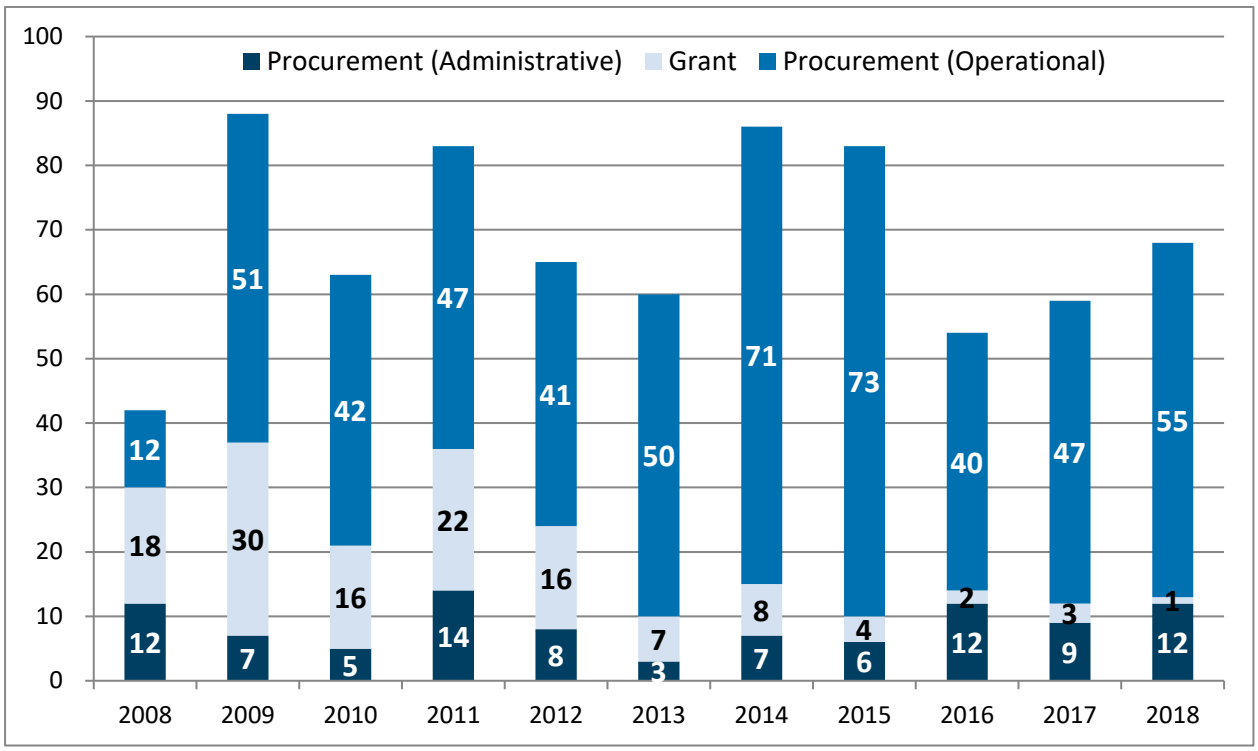


Figure 38: Procurement and grant procedures launched

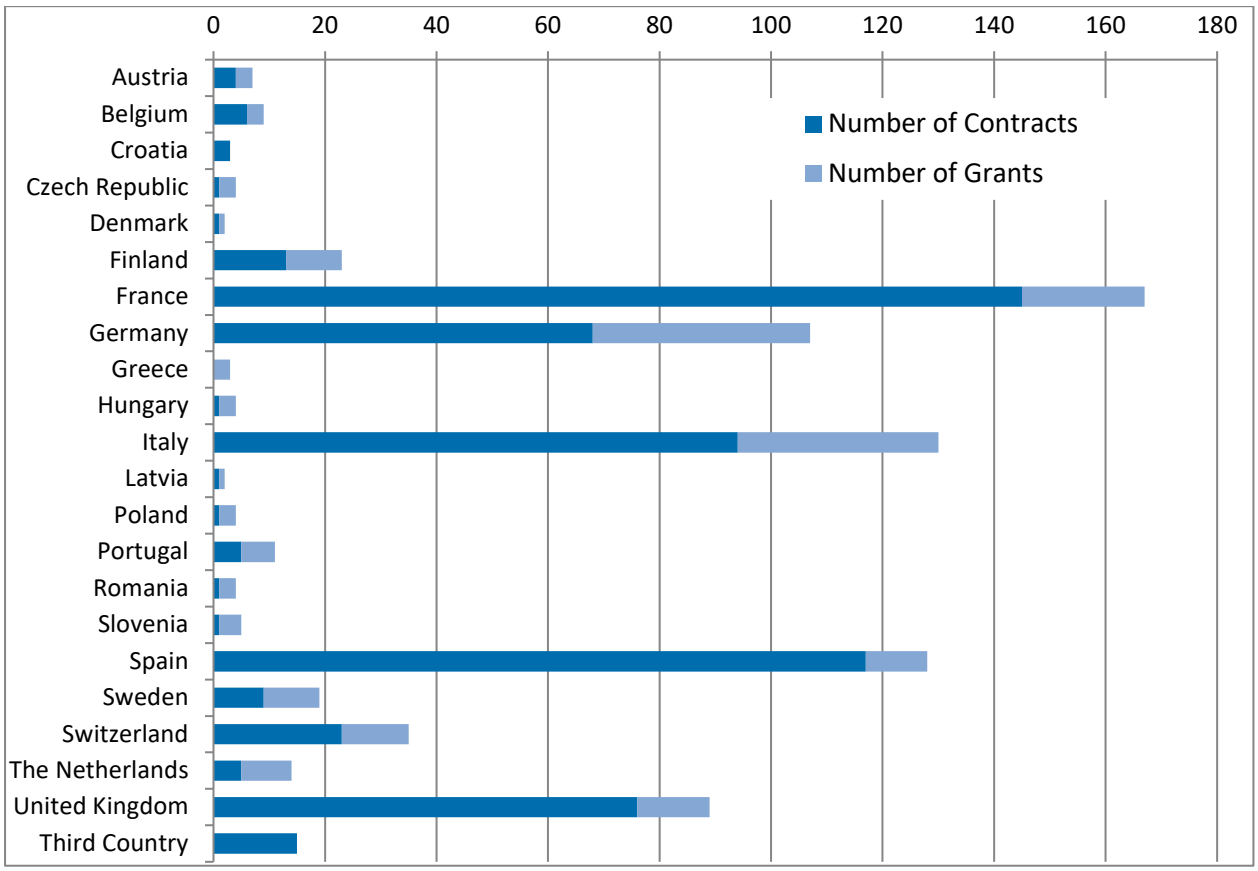


Figure 39: Geographical distribution of awarded contracts and grants (Number in the period 2008-2018)

The geographical distribution of awarded grants reflects the relative size of the fusion research communities in the different Member States. For what concerns the distribution of awarded procurement contracts, we can observe combined effect of the project location in France (with the consequent local attraction of participation) and of the relative size of industrial economies in the different Member States.

Annex II. d. Implementation of the F4E Work Programme 2018

2018 Work Programme		Grant		Procurement		Cash Contribution		TOTAL	
		Amount (€)	Variation (%)	Amount (€)	Variation (%)	Amount (€)	Variation (%)	Amount (€)	Variation (%)
B3-1 & B3-5 ITER Construction	Original WP	5 034 000	-	318 777 729	-	209 667 150	-	**533 478 879**	**-**
	Last amended WP	5 125 888	2%	221 668 452	-30%	385 362 404	84%	**612 156 745**	**15%**
	Execution	5 155 872	1%	235 471 501	6%	375 031 745	-3%	**615 659 118**	**1%**
B3-2 Technologies for ITER	Original WP	0	-	1 468 000	-	5 000 000	-	**6 468 000**	**-**
	Last amended WP	0	-	1 586 792	8%	5 410 000	8%	**6 996 792**	**8%**
	Execution	0	-	1 581 764	0%	7 501 868	39%	**9 083 632**	**30%**
B3-3 Broader Approach	Original WP	0	-	5 900 000	-	793 000	-	**6 693 000**	**-**
	Last amended WP	0	-	2 814 570	-52%	1 362 734	72%	**4 177 304**	**-38%**
	Execution	0	-	3 602 145	28%	0	-100%	**3 602 145**	**-14%**
B3-4 Other Expenditure	Original WP	0	-	8 477 000	-	0	-	**8 477 000**	**-**
	Last amended WP	0	-	6 058 593	-29%	0	-	**6 058 593**	**-29%**
	Execution	0	-	6 726 502	11%	0	-	**6 726 502**	**11%**
B3-6 Reserve Fund	Original WP	0	-	37 900 000	-	0	-	**37 900 000**	**-**
	Last amended WP	0	-	37 900 000	-	0	-	**37 900 000**	**-**
	Execution	0	-	3 158 446	-92%	0	-	**3 158 446**	**-92%**
TOTAL	**Original WP**	**5 034 000**	**-**	**372 522 729**	**-**	**215 460 150**	**-**	**593 016 879**	**-**
	Last amended WP	**5 125 888**	**2%**	**270 028 407**	**-28%**	**392 135 138**	**82%**	**667 289 434**	**13%**
	Execution	**5 155 872**	**1%**	**250 540 359**	**-7%**	**382 533 613**	**-2%**	**638 229 843**	**-4%**

Variations: Last amended WP compared to Original WP and Execution to Last amended WP

Flexibility Clause of the Work Programme

A **'flexibility' clause** has been introduced in the Work Programme 2018 in order to limit the changes in the implementation of the budget compared to the substance of the Work Programme adopted by the Governing Board, and last defined in the Article 2 of the Governing Board decision approving the second amendment to the Work Programme 2018[19]:

The Governing Board hereby delegates to the Director of Fusion for Energy the power to make non substantial amendments to the annual Work Programme approved by the Governing Board. Amendments are considered to be "non-substantial" if

(a) they do not lead to an increase of:

[19] *F4E(17)-GB39-5.4_2nd Amendment of the 2018 Work Programme*

i. more than 10% of the Financial Resources allocated to the corresponding Action in the Annex V of the annual Work Programme for the year, or more than EUR 0.2 million for Actions with allocation of below EUR 2 million for the year; and

ii. more than 3% of the total operational expenditure in Title 3 of the annual Budget for the given year

and if:

(b) any related changes to the scope of the annual Work Programme do not have significant impact on the nature of the Actions or on the achievement of objectives of the multiannual Project Plan.

Non-substantial amendments shall not lead to any increase in the total operational expenditure for Title 3 of the annual Budget approved by the Governing Board."

The Budget 2018 has been implemented in full respect of this flexibility clause:

Implementation of the Work Programme (EUR)

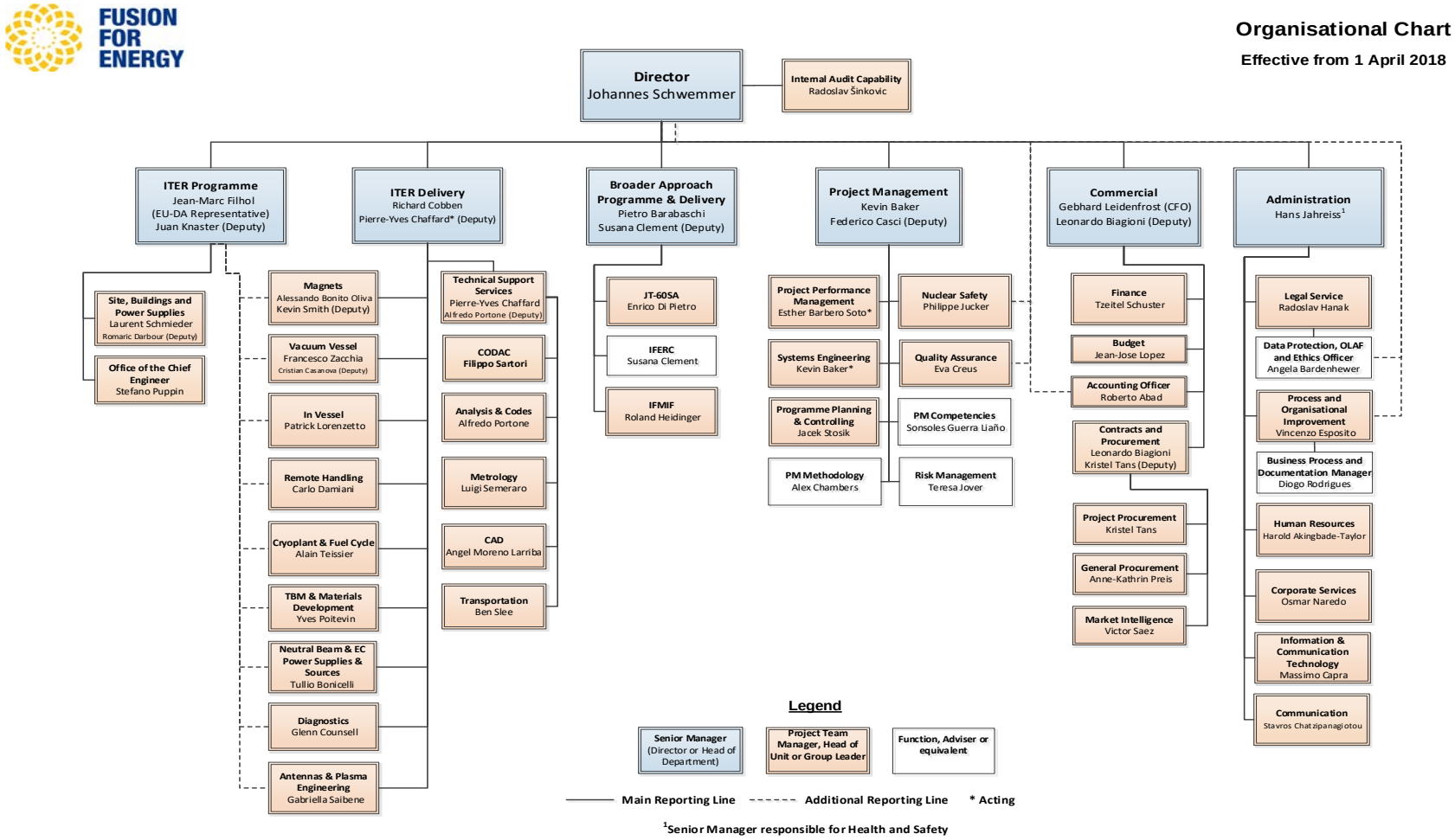
(eur)

Actions of the 2018 Work Programme	Commitment Appropriation				
	Original WP	First Amending WP	Second Amending WP (Final)	Final Implementation	% implementation
Action 1: Magnets	7 847 990.00	9 056 648.39	9 745 950.00	9 148 497.53	-6.1%
Actions 2,3,4,10: Main Vessel systems	42 943 516.87	42 075 026.42	37 126 710.00	37 575 422.11	1.2%
Action 5: Remote Handling	15 133 570.00	13 796 859.75	4 612 591.00	4 109 392.53	-10.9%
Action 6: Cryoplant & Fuel Cycle	13 102 020.00	18 647 080.00	10 246 793.00	9 464 386.65	-7.6%
Action 7: Antennas and Plasma Engineering	4 030 000.00	3 695 283.60	3 347 594.00	3 407 216.05	1.8%
Action 8:Neutral Beam and EC Power Supplies and Sources	24 571 450.00	49 675 395.84	44 000 000.00	44 934 792.52	2.1%
Action 9: Diagnostics	18 265 970.79	7 819 648.41	9 039 000.00	8 414 764.16	-6.9%
Action 11: Buildings, Infrastructures & Power Supplies	220 006 401.66	245 310 525.62	315 981 877.00	313 186 831.76	-0.9%
Action 12: Cash Contributions	207 987 160.00	204 104 569.00	214 780 434.00	193 285 597.57	-10.0%
Action 13: Supporting Activities	32 385 800.00	16 332 841.84	14 322 181.00	11 191 797.42	-21.9%
Action 14: Broader Approach	6 743 000.00	6 746 970.36	4 086 304.00	3 999 757.84	-2.1%
TOTAL	593 016 879.32	617 260 849.23	667 289 434.00	638 718 456.14	-4.3%

The final implementation was significantly lower than forecasted for the following actions:

- Action 5: Remote Handling: - € 0.6m: Some activities for the Development of Divertor Remote Handling & Preparation of Final Design have been postponed to 2019.
- Action 12: Cash Contributions: - € 10.8m: This is the result of a combination of effects, in particular a partial commitment of the 2020 cash contribution to the ITER Organization.
- Action 13: Supporting Activities: - € 3.1m: At the time of establishing the forecast, it is not possible to define all supporting activities. Therefore, the forecast is replaced by budgetary envelopes which cover all possible activities during the year – thus explaining why the budget execution is lower than originally foreseen.

Annex III. Organisational Chart



Disclaimer: The content of this structure is for information purposes only and does not infer any rights

Annex IV. Establishment Plan and Additional Information on Human Resources Management

Annex IV. a. Establishment Plan

	Authorised Posts (EP 2018)		Filled as of 31/12/2018	
	FO	TA	FO	TA
AD 16	0	0	0	0
AD 15	0	1	0	0
AD 14	3	1	0	1
AD 13	14	7	8	6
AD 12	15	17	11	4
AD 11	4	21	5	21
AD 10	0	26	2	20
AD 9	0	35	5	49
AD 8	1	40	5	41
AD 7	0	28	1	18
AD 6	1	28	1	35
AD 5	1	0	0	0
Subtotal	**39**	**204**	**38**	**195**
Total AD	**243**		**233**	
AST 11	4	0	0	0
AST 10	2	0	1	0
AST 9	3	0	2	0
AST 8	2	1	1	0
AST 7	1	1	2	1
AST 6	0	8	1	1
AST 5	0	12	2	13
AST 4	0	5	2	5
AST 3	0	1	1	11
AST 2	0	0	1	0
AST 1	0	0	0	0
Subtotal	**12**	**28**	**13**	**31**
Total AST	**40**		**44**	
Total FO/TA	**283**		**277**	

Annex IV. b. Entry Level for Each Type of Post: Indicative Table

Key functions	***Type of contract (FO, TA, CA)***	***Function group, grade of recruitment (or bottom of the brackets if published in brackets)***	***Indication whether the function is dedicated to administrative support or operations***
Head of Department (level 2, taking the Director as level 1)	FO/TA	AD13	Administrative/Operations
Head of Unit/Project Team Manager (level 3)	FO/TA	From AD9	Administrative/Operations
Group Leader (level 4)	FO/TA	From AD6	Operations/Neutral
Senior Officer	FO/TA	From AD9	Administrative/Operations/Neutral
Officer	FO/TA	From AD5 to AD8	Administrative/Operations/Neutral
Assistant	FO/TA	From AST1	Administrative/Operations/Neutral
Head of Administration	TA	AD13	Administrative
Head of Human Resources	TA	AD11	Administrative
Head of Finance	FO	AD10	Neutral
Head of ICT	TA	AD10	Administrative
Secretary/Clerk	CA	II	Administrative/Operations/Neutral
Mail Clerk	Interim	II	Administrative
Data Protection Officer	FO	AD12	Administrative
Accounting Officer	FO	AD7	Neutral
Internal Auditor	FO	AD7	Administrative
Administrative Support to the Director	CA	III	Operations

Annex IV. c. Benchmarking Exercise

Screening type	Screening category	Description	Year 2018* (%)	Year 2017* (%)
Administrative Support and Coordination (overhead)	**Administrative support**		**12.42 %**	**12.63 %**
	DOC	Document management	0.00 %	0.00 %
	HR	Human resource management	4.28 %	4.07 %
	IA	Internal auditing and control (procedural aspects)	0.86 %	0.86 %
	ICT	Information and communication technologies	4.07 %	4.28 %
	LOG	Logistics, facilities management and security	2.78 %	3.00 %
	RES DIR/HoA	Head of Administration	0.43 %	0.43 %
	Coordination		**1.71 %**	**1.71 %**
	LEGAL	Legal (administrative matters, including DP)	0.43 %	0.43 %
	COMM	External communication & information	1.07 %	1.07 %
	GEN COORD	General coordination activities	0.21 %	0.21 %
			74.95 %	**74.52 %**
Operational	TOP COORD	Top operational coordination (Director/HoD)	5.57 %	5.14 %
	PGM M/IMP	Programme management and implementation	64.67 %	64.67 %
	EVAL	Evaluation and impact assessment	1.28 %	1.28 %
	GEN OPER	General operational activities	3.43 %	3.43 %
			10.92 %	**11.13 %**
Neutral	FIN	Finance, accounting, contract management and administrative procurement	6.64 %	6.42 %
	CONT	Quality management and internal audit and control (with focus on financial aspects)	4.28 %	4.71 %

* Posts allocated in the Staffing Plan (Staff members and SNEs)

Annex IV. d. Flexitime scheme in 2018

Category	Grade	Extra hours (days)	Recuperation (days)
AST	2	10.10	2.50
	3	12.99	3.05
	4	13.00	2.92
	5	23.12	6.06
	6	37.24	0.00
	7	27.64	8.75
	8	17.59	4.50
	9	0.27	0.25
	10	24.05	3.00
AD	6	27.71	12.44
	7	16.31	2.33
	8	31.49	7.11
	9	35.20	7.47
	10	28.49	5.23
	11	38.80	5.56
	12	56.85	5.23
	13	71.89	0.06
II	4	1.06	0.00
	5	8.00	4.00
	6	4.61	0.79
	7	17.55	5.88
III	8	4.51	1.00
	9	4.14	1.60
	10	6.30	2.54
	11	8.21	2.13
IV	13	8.67	2.36
	14	13.36	2.51
	15	7.36	2.62
	16	10.52	3.57
	17	27.87	11.50
	Average in F4E	14.65	3.34

Annex V. Human and Financial Resources by Activity

Actions	Final 2018 execution (EUR)		Staff
	Commitments	Payments	
ADMINISTRATIVE EXPENDITURE	56 299 476.72	53 872 063.44	118
ITER CONSTRUCTION INCLUDING THE ITER SITE PREPARATION	626 000 251.90	744 096 521.40	309
TECHNOLOGY FOR ITER	9 083 632.35	7 871 073.36	10
TECHNOLOGY FOR BROADER APPROACH AND DEMO	3 602 145.19	8 147 792.42	30
TOTAL	**694 985 506.16**	**813 987 450.62**	**467**

The numbers provided in the table above show a summary of the situation at 31 December 2018.

Annex VI. Open Court Cases involving F4E in front of the Court of Justice of the European Union in 2018

- T-561/16 - Galocha vs. Joint Undertaking Fusion for Energy