ITER & Fusion Research

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# ITER & Fusion Research

***The Commission has adopted a Communication to the European Parliament and the Council which concludes that in view of substantial overall cost increases for International Thermonuclear Experimental Reactor (ITER), which have more than doubled the costs for Europe (to around €7.2 billion instead of an initial expected €2.7 billion), a sustainable financial framework should be established. Member States should provide a clear financial commitment throughout the life of the project and a mechanism for dealing with any further overruns should be agreed, subject to an overall cap. In particular, a total of around €1.4 billion is needed to meet the estimated cost increases in the EURATOM Community contribution to ITER in 2012 and 2013. This funding should be found either by raising the ceiling in the EU budget or through additional finance directly from the Member States.***

ITER is an international collaborative project (EU, US, China, Japan, India Russia, South Korea) to demonstrate the potential of nuclear fusion as an energy source. It is one of the world's most ambitious research endeavours. Its results could dramatically change the world's energy landscape opening the way to a **safe, affordable, inexhaustible and CO2-free source of energy**.

The European Union wants to ensure the success of the project at acceptable cost and with reasonable financial and technical risks. The critical step for the project is now for the international partners in ITER to agree on the project's "Baseline", in other words its scope (specifications of the fusion reactor to be built), the schedule (time table for construction) and the cost. The aim is for this to be agreed at the next meeting of the ITER Council, which includes representatives of all the participating countries, scheduled for mid-June 2010.

The full text of the Communication will be available at:

http://ec.europa.eu/research/energy/euratom/pdf/iter_communication_may_2010_en.pdf

http://ec.europa.eu/research/energy/euratom/pdf/iter_communication_may_2010_fr.pdf

http://ec.europa.eu/research/energy/euratom/pdf/iter_communication_may_2010_de.pdf

**What is ITER?**

ITER is an experimental reactor which will reproduce the physical reaction - fusion - that occurs in the sun and stars. Previous experiments have already shown that it is possible to replicate this process on Earth. ITER aims to do this at a scale and in conditions that will demonstrate the scientific and technological feasibility of fusion as an energy source.

ITER will be capable of generating 500 million watts (MW) of fusion power and will be the basis for a demonstration power plant, (called DEMO), which will be the last step leading to the commercialisation of fusion power. ITER is being built in Cadarache (South of France) where the Headquarters of the ITER Organization is also based.

**What is fusion?**

When the nuclei of light atoms come together at very high temperatures, they fuse and this produces enormous amounts of energy. In the core of the sun or a star, the huge gravitational pressure allows this to happen at temperatures of around 10 million degrees Celsius. At the much lower pressures that we can produce on Earth, temperatures to produce fusion need to be much higher – above 100 million degrees Celsius. To reach these temperatures there must first be powerful heating, and thermal losses must be minimised by keeping the hot fuel particles away from the walls of the container. This is achieved by creating a "cage" made by strong magnetic fields, which prevent the particles from escaping. The development of the science and technology involved in this process is the basis of the European fusion programme.

**What are the attractions of fusion as an energy source?**

The key advantages are:

- It could provide a large-scale energy source with basic fuels which are abundant and available everywhere;
- Very low global impact on the environment – no CO2 greenhouse gas emissions;
- Day-to-day-operation of a fusion power station would not require the transport of radio-active materials;
- Power stations would be inherently safe, with no possibility of "meltdown" or "runaway reactions";
- There is no long-lasting radioactive waste to create a burden on future generations;
- While development and capital investment costs are high, the marginal cost of supply is expected to be negligible compared to that of energy derived from fossil fuels.

Worldwide access to a safe, inexhaustible and emission-free source of energy could constitute a decisive step towards successfully fighting climate change, provide a massive and lasting boost to the European and global world economy and by increasing energy security across the world, could also reduce geopolitical tension.

**How does fusion technology fit in with wider European energy policy?**

The Union's vision set out in the Strategic Energy Technology (SET) Plan is of 'a Europe with a thriving and sustainable economy, with world leadership in a diverse portfolio of clean, efficient and low-carbon energy technologies as a motor for prosperity and a key contributor to growth and jobs'. Fusion and ITER are enlisted in the SET Plan as part of a new generation of technologies necessary to meet the 2050 vision towards complete decarbonisation. The SET Plan states as a key objective '*…Complete the construction of the ITER fusion facility and ensure early industry participation in the preparation of demonstration actions*'.

**When will fusion power become available?**

The international ITER agreement of November 2006 has an initial duration of 35 years in order to construct (10 years), operate (20 years) and de-activate (5 years) the ITER facilities.

The construction period, the most intense in terms of resource needs will culminate in the so-called "First Plasma", the physics process materialising the start of operation;

It will be followed by an operation phase during which ITER will be progressively brought to its full performance capabilities.

The knowledge and experience gained after the first ten years of ITER operation combined with additional materials development will allow designing and constructing a demonstration reactor (DEMO) which should produce electricity around 2040. DEMO will be the last link towards the economic exploitation of fusion power starting from around 2050.

**Who are the Parties to ITER?**

ITER is an international joint venture with seven Members that represent over half the world's population and 80% of the planet's GDP, namely: the EU (European Atomic Energy Community-Euratom), China, India, Japan, Russia, South Korea and the United States. This scale of collaboration is comparable only with the International Space Station. In October 2007, the ITER Agreement entered into force, kicking off the construction of ITER.

**How is ITER financed?**

During construction, the principal contribution from the seven partners will be "in-kind" (i.e. by providing directly the components themselves, rather than the financing for them). The EU as host party will contribute around 45% of ITER's estimated construction costs while the rest is equally divided amongst the other six parties. During the operation and deactivation phases, Euratom will contribute to 34% of the total costs.

**How is the EU's contribution managed and delivered?**

EU's commitments to the ITER Agreement is delivered through the European Joint Undertaking for ITER – "Fusion For Energy" (F4E), established as the European Domestic Agency by the Council in March 2007[1] and based in Barcelona. Under the ITER Agreement each Member has its own "Domestic Agency" responsible for managing its contribution, and especially for procuring the various components needed to build ITER and to be provided to ITER Organization as contributions in kind .

**How is the Governance of F4E structured?**

The 27 EU Member States plus Switzerland are in the driving seat of F4E and hold 65 votes out of a total of 70 votes in its Governing Board. Euratom (in practice the Commission) has five votes and no veto.

**How much will it cost to build ITER and how much more will the EU have to pay?**

The 2001 cost estimates – reached collectively by all the international partners – put the total ITER construction cost at around €5.9 billion (expressed at 2008 prices). The Euratom contribution, amounted to around €2.7 billion in 2008 value), corresponding to around €1.75 billion for the components/systems to be provided "in kind", and around €950 million to be provided "in cash" to the ITER Organization. Each party has committed to provide the agreed contributions in kind independently of the final cost of procuring and delivering those components.

The F4E current cost estimates for the ITER construction period (2007-2020) amount to EUR 7.25 billion (cost for Europe only, in 2008 value): EUR 6.6 billion for the European contribution to ITER construction and EUR 650 million for the F4E running costs and other activities towards a demonstration fusion reactor.

These cost estimates are linked to the construction schedule currently used as a working basis. They were presented to the F4E Governing Board in March 2010. more than a doubling of the Euratom contribution to ITER construction is thus required compared to the initial estimates.

The provisions in the Multiannual Financial Framework (2007-2013), covering the Euratom FP7 and programmed expenditure for 2012 and 2013, were made on the basis of the initial cost estimate, and the need to establish the Domestic Agency, F4E. The shortfall for the ITER construction over the remaining period (2012-2013) of the current financial framework is about EUR 1.4 billion (in current value).

**How many jobs is ITER creating during its construction phase? Is there an estimate for jobs and growth created in the future?**

As experience has shown, large scale application of leading-edge technologies in scientific infrastructures stimulates innovation and increases competitiveness of European high-tech industries throughout the construction period well before the project starts yielding its scientific results.

It is likely that about three-quarters of the overall European contribution to ITER will result in contracts with European high-tech industries.

ITER will constitute a significant economic stimulus, creating a large number of high-quality jobs in civil, mechanical, electrical and nuclear engineering, during the construction period and will directly employ thousands of scientists from all over the EU and the world, during its construction and operation

In the longer-term, the potential for creating sustainable growth and jobs is huge, but exact figures are hard to quantify at this stage given that the project is only in the construction phase.

**Why have the initial cost estimates proved to be insufficient and how have they been updated?**

In 2001, the overall ITER construction costs were estimated to be 5.9 billion EUR (in 2008 value) spread over a period of 10 years. These initial cost estimates were based on a generic design that had to rely upon the 'best available knowledge' at that time, in other words on findings of the scientific community supported by industry. Following signature of the ITER agreement in November 2006, one of the first priorities was to conduct a Design Review of ITER. This review was finished in June 2008 and led to an increase in the estimate of the project's cost.

Since the establishment in 2007 of the ITER Organization and the setting up of F4E, additional cost increases associated to the development of the ITER Baseline have emerged and have been regularly reported by the F4E Director to the 27 EU Member States and Switzerland in the F4E Governing Board.

**What are the underlying reasons for the cost increases since 2001?**

The original estimates for Euratom contributions have evolved since the original calculations in 2001 to take account of:

- the revised actual costs to Euratom of meeting its obligations for contributions in kind, which were assessed during 2008 by an Ad-Hoc Group to the F4E Governing Board chaired by R. Toschi.
- the ITER international organisation's revised costs related to the design and the management resources needed, which were assessed by an international experts panel set up by the ITER Council and chaired by F. Briscoe.
- the costs of operation and other activities of F4E following its establishment in 2007 which were not part of the 2001 cost estimates

The expert panels identified a number of factors arising from significant changes in circumstances and the parameters of the work necessary and contributing to the increases of cost estimates between 2001 and 2008. The most important factors relate to:

- increased complexity of project integration in managing interfaces across seven ITER Parties (in 2001 only 3 Parties were foreseen to execute the project);
- the start-up costs of establishing new autonomous organizations Prices for most of the raw materials needed (steel, concrete, copper etc) have increased much faster than general inflation (3 to 5 times);
- the level of completion of the design (needed to be developed to the point at which it can serve as the basis for industrial tenders);
- need for additional technical components to increase assurance of ITER success (not foreseen in 2001);
- resources needed for inspection and testing to assure quality to the standards required;
- the evaluation of contingencies.

In addition to these factors, some cost increases associated to the development of the ITER Baseline, in particular not to delay too much the construction schedule, have emerged between 2008 and 2010.

**Is the expected overrun only for 2012 and 2013? What about subsequent years?**

The cost estimates of the project are continually being improved and refined as is the case for large-scale and long-term infrastructures/research projects. Uncertainties around the current cost estimates for the early period of the construction phase have been significantly reduced mainly due to the progress on the designs and the assessments made by industry.

Beyond that early period of construction, it cannot be excluded that in later years further cost increases will emerge in the future through the later parts of the construction and the operation phases of the project (e.g. during the process of assembling the many thousands of components, coming from all over the world)..

**Who is responsible for the underestimates?**

First, in any undertaking of this size and complexity, cost estimates are just that – estimates. They depend on many variables, such as the cost of materials and labour, so cannot be precise.

Second, the 2001 estimates were drawn up and agreed not only by the Commission and all EU Member States, but also by the other six international partners.

**What will be done to stop them happening again?**

First, the management and operation of F4E has been revamped to further reinforce cost containment.

Second, the Commission's communication includes proposed mechanisms to ensure any future overruns are both minimised and can be met. In particular, a strong policy for cost containments already initiated both at the level of the ITER Organization and of F4E will have to be vigorously pursued in order to control and mitigate as much as possible further escalation of costs.

**Is the EU fully behind the ITER project and subject to which conditions? What is the Commission's specific view?**

The EU is united behind the ITER project.

In keeping with the EU's international commitments, and in light of the increasing strategic importance of efficient secure sources of energy for Europe, the Commission has repeatedly made clear that it is committed to moving forward with the ITER construction and operation but not at any cost.

The Council on 16 November 2009 reaffirmed its own unanimous support to ITER subject to the agreed conditions that need to be met, in order to ensure the success of ITER at reasonable cost and with acceptable risks, namely:

- credible cost assessments, acceptable cost and cost containment;
- realistic time table for the construction; and
- sound management of the project at all levels.

Such support was delivered "in the perspective of substantial cost increases". The EU wants to ensure the success of the project at a reasonable cost and with acceptable risks. The adoption of the project's Baseline (in other words scope, schedule and costs) is now planned for June 2010.

The commitment of the Council and the European Parliament to guarantee adequate financial support to the ITER project throughout its construction and operations phases is a pre-condition of sustainability.

**Why is the Commission not proposing to meet the overruns from within the existing EU budget? How can the Member States find this at a time of crisis?**

The overarching objective for the Commission is to establish not only a short-term solution but even more importantly a sustainable financial framework for the whole duration of the ITER project (construction and operation).

It would not be appropriate to consider drawing on budgetary means intended for important EU policies without assurance that Member States commit to

ITER for its whole duration.

The Commission is very conscious of the difficulties in public finances. But all Member States have endorsed the Europe 2020 principle that the best way to ensure sustainable recovery is by maintaining and increasing investment in the technology of the future.

Compared to the potential economic, environmental and geopolitical benefits of the ITER project, the investment required is well worth making. In addition, the project is a significant economic stimulus in the shorter-term.

The Communication makes clear that should Member States be ready to support ITER in the long term, the Commission will make proposals to finance additional needs for ITER in 2012 and 2013 in line with the inter-institutional agreement on the EU budget

**Why can the costs not be met through an EIB loan?**

This would be difficult because in general EIB loans are intended to finance activities which will generate a revenue stream in the relatively short-term, allowing the loans to be repaid within that timescale.

**Do international partners also need to find extra funds?**

Yes, although in proportionately smaller amounts than the EU in the construction phase of the project, because the EU's contribution to the construction phase (45%) is greater, to reflect the fact that the project is sited in the EU and much of its early procurement is being undertaken by F4E. As the project continues, the EU's proportionate contribution will fall to 34% and that of other partners increase.

**Could the construction costs rise again in the future?**

ITER is a unique and challenging endeavour. To build the ITER device, a multiplicity of parts at the boundaries of current technology and coming from all around the world, will have to be assembled.

The recent cost assessment exercises have aimed precisely at incorporating all parameters known today to provide a sound basis for years to come. Given the increased level of maturity of the design and the implementation of costing methodologies that could take into account more detailed data on the project, these estimates are not expected to undergo material variation in the short term.

**Quelles ont les obligations financières de la France, en tant que pays hôte du site de Cadarache ?**

Dans le contexte du choix du site d'ITER à Cadarache, la France s'est engagée à apporter des contributions financières qui font partie de la contribution Européenne au projet ITER. Ces contributions s'ajoutent aux contributions provenant du budget de la Communauté EURATOM.

La contribution de la France au financement de la construction de la machine s'élève à 10% de son coût. De plus, la France pourra financer à hauteur de 8% la phase d'exploitation, incluant la mise à l'arrêt et le démantèlement du réacteur.

**What progress has Europe made so far on delivering its commitment to lead the construction phase?**

In 2009 Europe was able to deliver on a number of key technology milestones for ITER, namely completing the levelling of a 120-hectare platform for the machine, significant progress on design specifications for key ITER components, such as magnets, vacuum vessel and fuelling systems, etc. During 2009, more than 100 calls for procurement (to manufacture ITER components) and grants (to finance Research and Development actions) have already been launched by F4E that are worth about € 230 million.

Already in April 2010 a very important contract, the Architect Engineering contract for ITER buildings was signed between F4E and the ENGAGE consortium of European industries. The Architect Engineering contract worth € 150 million represents the biggest contract awarded so far in the scope of the ITER project. It is expected that more than 230 engineers and designers will be working under this contract. The ENGAGE consortium will perform the design and follow-up of the construction of the ITER Buildings and Site Infrastructure, comprising 29 of the 39 ITER buildings over an area of 50 hectares. In 2010, the F4E budget related to procurements and grants for ITER amounts to about € 290 million.

[1] :

OJ L 90, 30.3.2007, p.58